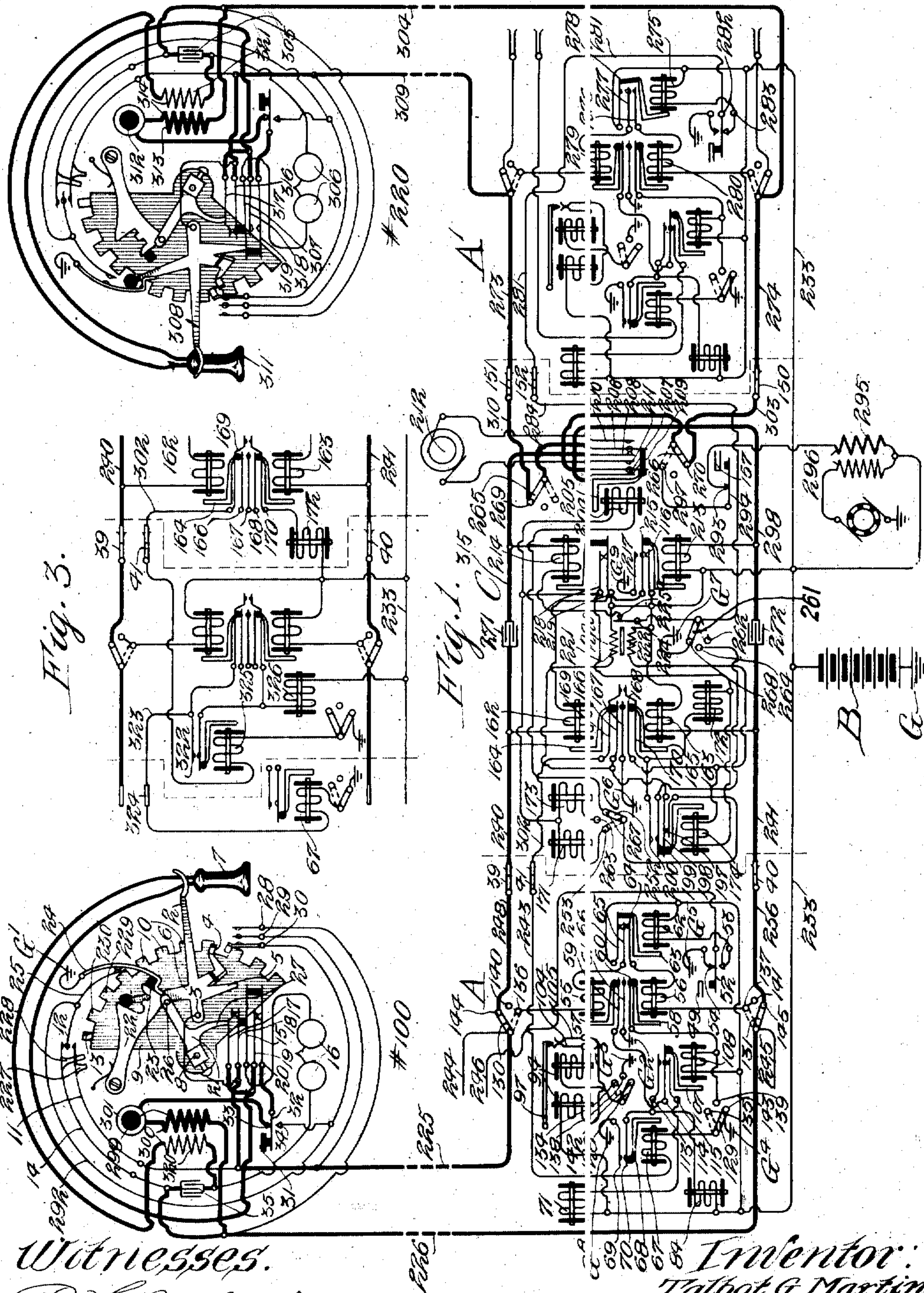


T. G. MARTIN.
COMMON BATTERY AUTOMATIC TELEPHONE SYSTEM.
APPLICATION FILED APR. 9, 1906.

1,223,506.

Patented Apr. 24, 1917.

2 SHEETS—SHEET 1.



Witnesses.
R. H. Burfield
A. Anderson.

Inventor:
Talbot G. Martin,
By Bulley & Swann
Attorneys.

T. G. MARTIN.
COMMON BATTERY AUTOMATIC TELEPHONE SYSTEM.
APPLICATION FILED APR. 9, 1916.

1,223,506.

Patented Apr. 24, 1917.

2 SHEETS—SHEET 2.

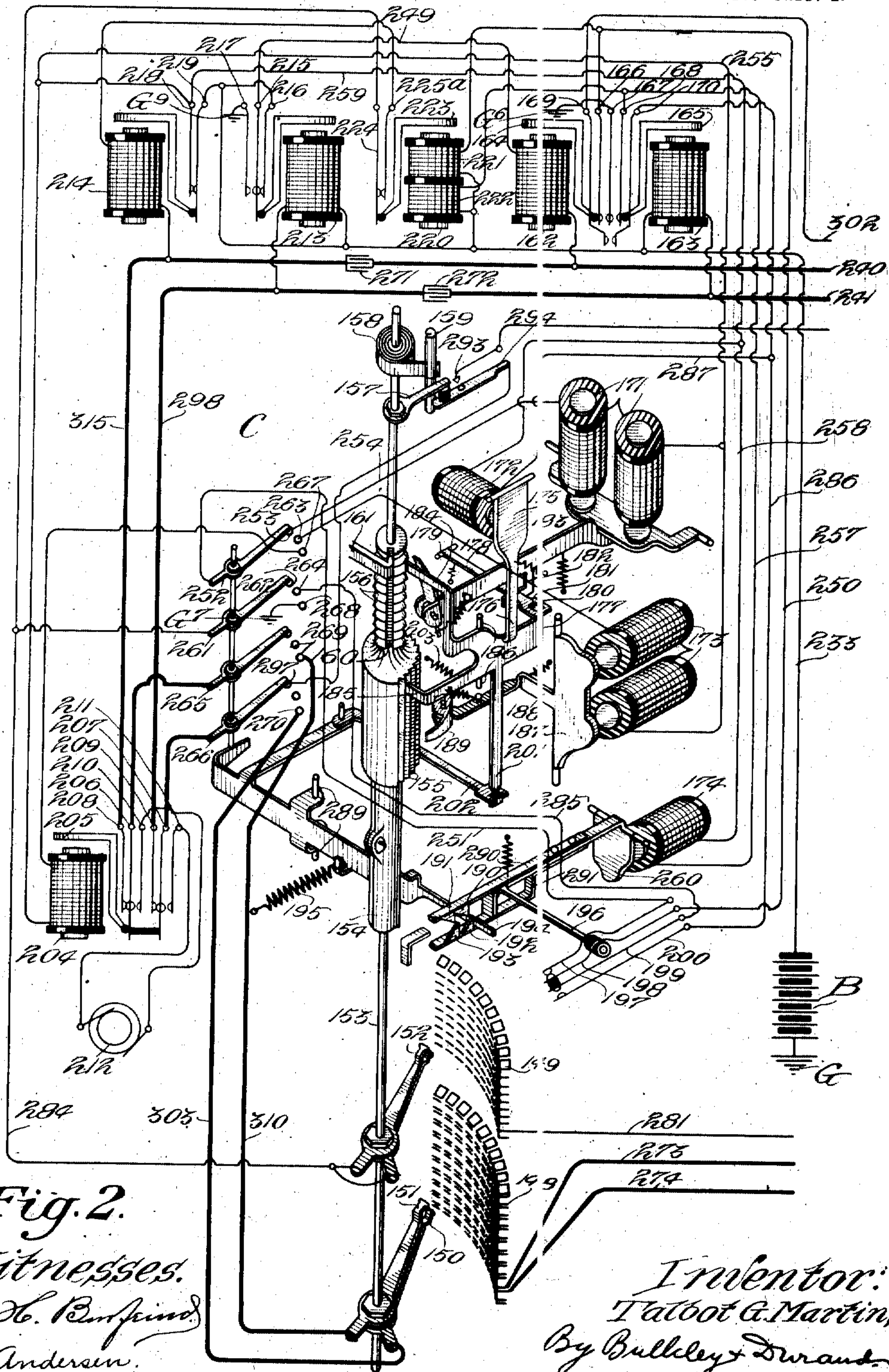


Fig. 2.

Witnesses:
R. H. Benford
A. Andersen.

Inventor:
Talbot G. Martin,
By Bulkeley & Durand
Attorneys

UNITED STATES PATENT OFFICE.

TALBOT G. MARTIN, OF CHICAGO, ILLINOIS, ASSIGNOR, BY MESSE ASSIGNMENTS, TO
AUTOMATIC ELECTRIC COMPANY, A CORPORATION OF ILLINOIS.

COMMON-BATTERY AUTOMATIC TELEPHONE SYSTEM.

1,223,506.

Specification of Letters Patent.

Patented Apr. 24, 1917.

Application filed April 9, 1906. Serial No. 310,855.

To all whom it may concern:

Be it known that I, TALBOT G. MARTIN, a citizen of the United States of America, and resident of Chicago, Cook county, Illinois, have invented a certain new and useful Improvement in Common-Battery Automatic Telephone Systems, of which the following is a specification.

My invention relates to automatic telephone systems in general, but more particularly to automatic systems in which step-by-step switching machinery is employed at the exchange, and especially to automatic telephone systems in which connectors are employed for completing connection with the called subscribers' lines.

Generally stated, the object of my invention is the provision of an improved and highly efficient common battery automatic telephone system.

Special objects are the provision of an improved construction and arrangement whereby the current for talking purposes is fed to the talking circuits through certain coils or windings of the connectors or switching machines by which connection is completed directly with the lines of the called subscribers; the provision of an improved construction and arrangement whereby current for both talking and switching purposes is supplied to the subscribers' lines from a battery or other suitable centralized source of current supply, and whereby differential and pole-changing relays are advantageously employed in the connectors to control certain switching operations, as well as the supply of talking current to any and all temporarily established talking circuits; and the provision of certain details and features of improvement, improved circuit arrangements and combinations tending to increase the general efficiency and serviceability of a telephone system of this particular character.

To the foregoing and other useful ends, my invention consists in matters hereinafter set forth and claimed.

In the accompanying drawings, Figure 1 is a diagrammatic representation of the circuits, sub-stations and central office switching arrangements through which the sub-station #100, for example, obtains connection with the sub-station #220; and it will be seen that the central apparatus comprises among other things the first-selector A and

a central or common battery B for supplying all current, the connector C and the first-selector A¹ of the called line.

Fig. 2 is a perspective diagrammatic view of the connector switch C.

Fig. 3 is a diagrammatic view showing the additional release-circuits employed when a second-selector is used in addition to the first-selectors and connectors shown in the preceding figures.

The sub-stations all being of the same construction, it will be sufficient to describe only one in detail. It will be understood, however, that since the parts are shown in diagram they are represented in positions that will make the description clearest. The drawings show the sub-stations #100 and #220; but it will be necessary to consider that, looking at the drawings, the dial, by means of which the subscriber makes his call, is turned at the sub-station #100 in a counter-clockwise direction and allowed to return to its normal position in a clockwise direction, while at the sub-station #220 the operations are performed in just exactly the opposite direction. The sub-station #100 is of the well-known type in which a switch-hook 2 that is pivoted at a point 3 is provided with a number of arms 4, 5 and 6 for controlling the sub-station circuits. The said switch-hook is normally retained depressed in a position shown at sub-station #220 by the receiver 7, but when the receiver is removed the said switch hook, by the power of a spring not shown, rises to a position indicated at the sub-station #100. Near the center of the so-called keyboard or sub-station mechanism a shaft 8 is located at right angles thereto and supports a so-called impulse-wheel 9 secured to said shaft rigidly. Said impulse-wheel is provided with a number of peripheral teeth 10 which are adapted, when the said dial is rotated in a left-hand or counter-clockwise direction, and then permitted to return in a clockwise direction, to engage the so-called vertical finger 11 one at a time. The vertical finger 11 is, therefore, caused to interruptedly come into contact with the so-called ground-post 12, and after the last tooth clears the said finger the tooth 13 upon the other side of the impulse-wheel engages the so-called rotary finger 14 and gives it one impulse against the same ground-post 12. When the switch-hook 2 is down—that is, when the receiver is upon

60

65

70

75

80

85

90

95

100

105

110

the switch-hook—the cam-arm 5 is in engagement with the ringer circuit spring 15, thereby establishing the ringer circuit through the ringer 16 across the subscriber's line. Under such conditions, as shown at sub-station #220, the springs 17 and 18 are pressed apart, as well as the springs 19 and 20. The former two of said springs control the continuity of the secondary circuit that includes the secondary winding of the sub-station induction-coil at the sub-station #100, while the latter two control the continuity of the primary circuit through the primary winding of said induction-coil, and through the subscriber's transmitter. Upon the same shaft with the impulse-wheel 9 there is a member or cam-dog 21 that works in conjunction with a lock-cam 22 to so lock the dial that it may not be turned while the receiver is on the switch-hook. When the switch-hook 2 rises the cam-arm 6 raises the locking-cam 22 until the insulating tip 23 nearly clears the hooked end of the ground-spring 24, which latter it controls with respect to the spring 25. But the said insulating tip does not fall behind said locked end until the dial is pulled around the first time, at which time the pin 26 on the end of the cam-dog 21 drives the lock-cam 22 up a little farther, at which time the ground-springs 24 and 25 come into contact. Attention is called to the fact that the finger 27 of the cam-dog 21 (whenever the dial is out of normal position) leaves the spring 17, which latter then by reason of its own tension withdraws from the spring 18 and opens up the primary circuit, thereby disconnecting one side of the subscriber's line from the other. The sub-station is provided with three so-called release-springs 28, 29 and 30 which are so controlled by the cam-arm 4 that when the switch-hook descends the said release-springs are forced into contact for a moment and then disengaged; but when the switch-hook rises the said springs are not forced into contact. This is accomplished by means of parallel projections one of which is located upon the release-spring 30 and the other upon the release-arm 4. These projections are somewhat flat in structure and mounted at an angle, so that the under edge of the flange on the arm 4 in descending passes to the left of the upper edge of the flange on the spring 30, forcing the springs 30, 29 and 28 into contact; but when it is rising the upper edge of the former flange passes to the right of the lower edge of the latter flange. The substation #100 is further provided with a signaling or ringing-button 31 which controls a signaling-spring 32 with respect to the contact-points 33 and 34. There is also a condenser 35 in the secondary circuit, which will be described hereinafter. It will be noted from the preceding that the ground-post 12, after the switch-

hook has been raised, and the dial rotated forward, is connected to the ground terminal G¹ through the ground-springs 24 and 25.

The first-selector may be of any suitable, known or approved construction. The first-selector switch A shown in Fig. 1 is of the general type of selector switch disclosed in United States Letters Patent No. 815,321, granted March 13, 1906, to Keith, Erickson and Erickson, and comprises the usual mechanical details and circuit connections.

The connector C is of a particular type, being a common battery connector and provided with suitable relays, operating magnets, and circuits to be hereinafter described. The connector and first-selector are very similar, but in the provision of relays and circuits the two said switches are generally different. Like the first-selector A the said connector C is located above the line and private banks 148 and 149, respectively, with which the switch-shaft-wipers 150, 151 and 152 respectively engage. The said wipers, as in the first-selector, are mounted upon a switch-shaft 153, which shaft is, in addition, provided with the usual cam 154, longitudinal teeth 155, circular teeth 156, normal-post-arm 157, and coiled spring 158, the outer end of which latter is attached to the normal-post 159. The circular teeth 156 are traversed by the usual longitudinal slot 160 in which the shaft-rest 161 operates. The connector-switch like the first-selector has two line-relays, the vertical-line-relay 162 and the rotary-line-relay 163. These two relays between them and by means of their respective armatures 164 and 165 control the so-called line-relay-springs 166, 167 and 168 and in addition the trunk-release springs 169 and 170. The vertical-magnet 171, the release-magnet 172, the rotary-magnet 173 and the private-magnet 174 are severally similar to those described in the first-selector and perform similar functions. The release-magnet 172, however, as distinguished from the release-magnet of the first-selector, has its armature 175 located on the right side instead of on the left. Said armature is provided with an elongated member 176 for controlling the double-dog 177 at the release. Said double-dog is familiar and the exercising control of the said release-armature 175 will be hereinafter described. The release-link 178 of the connector, unlike the release-link of the first-selector, is permanently fixed by the pin 179 to a suitable part of the switch. Normally said release-link has a downward spring tendency and acts as a latch for retaining the double-dog 177 normally disengaged from the switch-shaft 153, at which time the upwardly-projecting pin 180 upon the upper side of the body of the double-dog 177 is retained within the aperture 181

provided upon the right extremity of the said release-link 178. The L-shaped piece 182 upon the under side of the vertical-arm 183 as usual reaches under said release-link and whenever the switch is brought into use and at the first upward movement of the said vertical-arm 183 the said L-shaped piece, as in the first-selector, wrenches the release-link from engagement with the pin 180. While the switch is in operation the said release-link is disengaged from the said double-dog 177 and rests with its end upon the pin 180 and with the vertical and rotary dogs 184 and 185 in engagement with the shaft 153. The double-dog 177 is returned from its operative to its normal position by the release-armature 175 when the release-magnet 172 is energized. At the energization of said magnet the elongated portion 176 of the release-armature 175 strikes the double-dog 177 to the right of its bearings 186, so that the pin 180 is driven under the aperture 181 of the release-link 178 and caught therein. The rotary-magnet-armature 187 of the connector is somewhat more simple than that of the first-selector. It is provided with the rotary-arm 188 and with the rotary-pawl 189 and is operated only when the switch-shaft 153 is raised. The shaft being raised, each time that the rotary-magnet 173 is energized it rotates the switch-shaft one step at a time in the same manner that the first-selector-shaft is rotated a step at a time by the first-selector rotary-arm. The private-magnet 174 is designed to control, in a step-by-step manner, the operation of the side-switch from first to second and from second to third positions by means of the escapement-teeth 190, 191, 192 and 193, and the escapement-finger 194, which operation results from the retracting tension of the side-switch retracting-spring 195. The private-magnet 174, furthermore, through the medium of the laterally-projecting arm 196, controls the four springs 197, 198, 199 and 200, so that when the said magnet 174 is energized the two springs (197 and 198) that normally rest in engagement are separated and the two springs (199 and 200) that normally are out of contact are closed into contact. It will be understood that the connector-switch-shaft 153, after being raised and rotated may be restored to normal position, together with the side-switch (the latter, of course, being out of normal position), at the energization of the release-magnet 172. The release-magnet 172 being energized after the switch has been operated, the side-switch is thrust into normal position by means of the double-dog release-arm 201 and the side-switch-link 202, through the medium of the release-armature elongated member 176, against the tension of the retracting-spring 203. At the same

time, the shaft being deprived of its locking member (the rotary-dog 185) is rotated by the retracting-spring 158 to normal rotary position, which shaft then, as usual, falls to normal vertical position. The connector is provided with a ringer-relay 204 for signaling the called subscriber. This relay, when the calling subscriber presses his signaling-button is energized in a manner to be hereinafter disclosed, and being thus energized causes its armature 205 to separate the ringer-relay-springs 206 and 207 from the normally engaging ringer-relay-springs 208 and 209, moving them onto the ringer-relay-springs 210 and 211. The action of said ringer-relay, as will be made evident, is to separate the calling subscriber's line from the called subscriber's line, and to bridge the latter line across the terminals of the ringer-generator 212. The energized condition of the said ringer-relay is maintained only as long as the calling subscriber presses the signaling-button. Upon the restoration of said signaling-button the calling and called lines are restored into connection. The connector is in addition provided with a so-called pole-changing-relay 213 and a circuit-controlling-relay 214. The former relay, namely the pole-changing-relay, when energized shifts the pole-changing-relay-spring 215 away from the spring 216 and onto the spring 217. The last of said springs is permanently connected to the grounded terminal of battery B while the spring 216 is permanently connected to the non-grounded terminal of battery B. The circuit-controlling-relay is designed to destroy, when energized, the normal connection between the ringer-relay 204, release-magnet 172, vertical-magnet 171, rotary-magnet 173, and private-magnet 174 and the non-grounded terminal of the battery B, by separating the spring 218 from the spring 219. Last of all there is found in the connector a differential-relay 220 with two windings 221 and 222. One of the terminals of the winding 221 is connected with one of the terminals of the winding 222, both of which terminals are connected to the non-grounded terminal of battery B. The other terminal of the winding 221 is connected to the line-relay-spring 166, while the other end of the winding 222 is connected to the line-relay-spring 168. This relay is so constructed that if both windings are energized at the same time the armature 223 is not attracted, but when only one winding is energized the armature separates the spring 224 from the spring 225* for the purpose of deenergizing at certain times the circuit-controlling-relay 214. It will be understood that the first-selector A¹ is the same as the first-selector A. The subscriber at substation #100, to op-

erate for the digit 2, removes his receiver from the switch-hook and then places his finger in the dial finger-hole numbered 2 and rotates said dial in a counter-clockwise direction until his finger meets a suitable dial-stop (not shown). Said stop limits the rotation that may be given to the said dial to correspond with the digit 2. The dial is then permitted to rotate back to normal position, which it does under the force of a suitable coiled spring usually provided in a telephone of the type shown in Fig. 1. Again the dial is rotated to correspond with the second digit 2; and for a third time the calling subscriber, by inserting his finger in the dial-hole numbered 0, rotates said dial until his finger strikes the finger-stop, after which it is permitted to again return to normal position. The first operation of the dial, in a manner to be described, operates the first-selector A and causes the latter to select a trunk-line to some idle connector, designated in Fig. 1 as connector C. The second and third operations of the dial operate the connector to cause it to connect the line of the calling subscriber with the line of the called subscriber, after which the latter may be signaled by the former pressing his signaling-button. When the calling subscriber removes his receiver from the switch-hook the cam-arm 5 leaves the spring 15 and destroys the circuit through the ringer 16 and at the same time permits the springs 18 and 20 to rise until they close contact with the springs 17 and 19, respectively. At the same time the cam-arm 6 raises the locking-cam 22 to a point that will permit the pin 26 upon the end of the cam-dog 21 to clear the locking-cam 22, when the dial is rotated, but not sufficiently to cause the insulating tip 23 to clear the angled section upon the ground-spring 24, so that even after the switch-hook is raised the ground-spring 24 is kept away from the ground-spring 25. But as soon as the dial is rotated in a counter-clockwise direction the cam-dog 21 raises the locking-cam 22 to a point at which the insulating tip 23 clears the angled section of the ground-spring 24 and thereby causes the ground-spring 24 to come into contact with the ground-spring 25. At the same time the finger 27 upon the cam-dog 21, being removed, permits the springs 17 and 18 to separate and thereby break the connection between the vertical and rotary line-conductors 225 and 226. The lugs 227 and 228 upon the vertical and rotary fingers 11 and 14, respectively, are twisted at an angle and retained in such a position that as the dial is rotated in a counter-clockwise direction the advancing edge of the tooth 13 upon the impulse-wheel 9 clears the right-hand edge of the lug 228 and strikes the said lug 228 at about the middle portion and then drives it away from the ground-post 12 without

bringing it into connection therewith. Immediately after, the lugs 10 upon the opposite side of the impulse-wheel 9 in a similar manner act upon the vertical impulse-finger 11. For the first digit (the digit 2) only two of the impulse-teeth pass to the rearward of the vertical impulse-finger-lug 227, and when the dial is returned to normal position the vertical impulse-finger 11 is pressed onto the ground-post 12 once as the tooth 229 passes across the lug 227, and once as the tooth 230 passes across the said lug; and immediately after the rotary impulse-finger 14 is pressed once onto the ground-post 12 by the rotary impulse-tooth 13. In this manner, and since the vertical impulse-finger 11 is connected with the vertical-line-conductor 225, and the rotary impulse-finger 14 connected with the rotary-line-conductor 226, at the return motion of the dial the vertical-line-conductor 225 is given two ground impulses and the rotary-line-conductor 226 one ground impulse. It is for the purpose of preventing the indicated ground impulses from passing from the vertical to the rotary line-conductor and vice versa that the springs 17 and 18 are separated while the dial is out of normal position. Each of the electrical ground impulses thus given the vertical-line-conductor 225 energizes the first-selector vertical-line-relay 55 once. The current each time passes from ground G^1 through the ground-springs 24 and 25 to the ground-post 12, thence to the vertical-line-conductor 225 and through the side-switch-wiper 130, contact-point 136 and to the vertical-line relay 55, thence through the bridge-cut-off-relay-springs 65 and 66 to the battery-lead 233, and to the non-grounded terminal of battery B and to ground G. The vertical-line-relay-armature 57, being attracted, forces the line-relay-spring 59 on to the ground-spring 61, energizing the vertical-magnet 71. The current in this last energizing circuit passes from ground G^2 through the line-relay-springs 61 and 59, private-springs 114 and 113 and vertical-magnet 71 to the battery-lead 233, and to the non-grounded terminal of battery B and to ground G. The first time that the vertical-magnet 71 is energized it attracts its armature and raises the shaft one step, the shaft being retained in its raised position when the vertical-magnet 71 becomes deenergized. The second time that the vertical-magnet is energized the shaft is raised a second step. It will be evident that at the end of the second step thus imparted to the switch-shaft the line-wipers 39 and 40 will be found opposite the first contacts of the second level of the line-bank, the private-wiper 41 opposite the first contact of the second level of the private-bank. Being thus raised the shaft is in a position to be rotated as soon as the rotary-line-relay 56 is ener-

gized. The energization of said rotary-line-relay occurs as soon as the rotary-line-conductor 226 is grounded. The current in the energizing circuit through the rotary-line-relay 56 flows from the ground terminal G^1 through the ground-springs 24 and 25 to the ground-post 12, thence through the rotary impulse-finger 14 to the rotary-line-conductor 226, side-switch-wiper 131, contact-point 137, the rotary-line-relay 56, through the bridge-cut-off-relay-springs 64, 65 and 66 to the battery-lead 233 and to the non-grounded terminal of battery B and to ground G. Being energized the rotary-line-relay 56 attracts its armature 58 and thereby causes the line-relay-spring 60 to be forced into contact with the ground-spring 61 for a moment. The private-magnet 108 is thereby energized over a circuit in which current flows from ground G^2 through the line-relay-springs 61 and 60, and private-magnet 108 to the battery-lead 233, to the non-grounded terminal of battery B and to ground G. The private-magnet being energized and deenergized, immediately after, the side-switch passes to second position, as described, and as a result the side-switch-wiper 128 engages the grounded side-switch contact-point 138. At once the rotary-magnet 94 is energized and the energizing current flows from ground G^3 to the side-switch contact-point 138 and through the side-switch-wiper 128, and rotary-magnet-coil 94 in series with the interrupter-springs 104 and 105 to the non-grounded terminal of battery B and to ground G. The rotary-magnet 94 then attracts the rotary-armature 97 and causes the shaft to be rotated one step. It will be understood that just about the time that the rotary-armature 97 strikes the rotary-magnet pole-pieces the rotary-dog falls behind the first of the longitudinal teeth to prevent the shaft from returning to normal position when the rotary-magnet becomes deenergized at the instant that the interrupter-finger forces the interrupter-springs 104 and 105 apart and thereby destroys the energizing circuit through said magnet. The said interruption occurs just at about the time that the rotary-armature strikes the rotary-magnet pole-pieces. When the rotary armature rotates the shaft it at the same time depresses the private armature and carries it down until the shaft-wipers 39, 40 and 41 are rotated onto the first level of their respective banks. As soon as the circuit through the rotary-magnet 94 is interrupted the rotary-armature begins to return to its normal position, and the private-armature as well, the latter following up the receding movement of the rotary-armature, and the side-switch springs into third position. The shifting of the side-switch takes place just before the interrupter-finger permits the interrupter-springs 104 and 105 to reengage, so that the energizing circuit that has been described through the rotary-magnet is destroyed at the point between the side-switch-wiper 128 and the contact-point 138. When the motion of the rotary-armature 97 ceases permanently the calling operation of the first-selector comes to an end. The line-wipers have then seized upon an idle trunk-line similar to the trunk line the conductors 240 and 241 of which are shown and which lead to an idle connector. The said seized trunk is protected from further seizure by a guarding potential that is established at the private-wiper 41 and, therefore, at all other private-bank-contacts connected in multiple thereto. Said guarding potential is established by reason of a connection between the ground terminal of battery B and said contacts and by way of the ground terminal G^4 , side-switch-wiper 129, back-release-relay 67, conductor 243 and private-wiper 41. It will be noticed that the subscriber's line-conductors 225 and 226 that terminate in the side-switch-wipers 130 and 131 have a couple of leads 244 and 245 connected one to the one side of the line and the other to the other side of the line. These conductors 244 and 245 are known as the line-normal-conductors and terminate in connector line-bank-contacts that correspond to the number of the subscriber #100. There is also a third conductor 246 that terminates in the switch-spring 52 and is known as the private-normal-conductor. When the first-selector-shaft is raised the said spring engages the spring 54 which is connected to the ground terminal G^5 , and as a result a guarding potential is established over the said private normal to the connector private-bank-contact that corresponds to the line-terminals of the subscriber #100. The said guarding potential being thus established, no calling subscriber may, as will be pointed out, connect with the calling line. In the same way that the first-selector has made the first trunk-line busy by placing a guarding potential at the first private-bank-contact of the second level of the private-bank, other private-bank-contacts may be made busy by other first-selectors. But if at the time that the calling subscriber #100 grounds the rotary-line-conductor 226 and shifts the first-selector side-switch to second position, as described, the first nine private-bank-contacts of the second level of the private-bank are then busy, the first-selector-shaft will not stop, as described, when the wipers are passed onto the first contact of the second level, but instead the private-magnet will retain the side-switch in second position until the shaft-wipers are rotated beyond the first nine busy-contacts and, therefore, onto the tenth contact. The first nine contacts being grounded, then when the

calling subscriber grounds the rotary side of the line, as described, the side-switch trips into second position as before; but then the rotation of the shaft begins and continues until the wipers have been carried beyond the last of the busy trunk-lines—in this case onto the tenth terminal of the second level of the banks in question. This continued or selective rotation takes place in the following manner: The energizing circuit through the rotary-magnet 94 being closed, at the juncture when the side-switch-wiper 128 engages with the contact-point 138, the rotary armature 97 is then attracted by the rotary-magnet 94 and the shaft rotated one step. The line and private wipers 39, 40 and 41 are, therefore, carried into engagement with the first terminal of the second level of their respective banks, and at the same time the private-armature 107 is depressed by the rotary-armature, and the interrupter-springs 104 and 105 (at the end of the stroke) are separated by the interrupter-finger 103. There being a guarding potential at the first contact which the private-wiper 41 meets a circuit is completed through the private-magnet 108 which extends from ground terminal G of battery B through the private-wiper of whatever first-selector is occupying the first trunk of the second level, and through the bank-multiplying-conductors to the contact-point with which the private-wiper is in contact, through the private-wiper 41, conductor 243, back-release-relay 67, side-switch-wiper 129, contact-point 139, private-magnet 108 to the battery-lead 233 and to the non-grounded terminal of battery B and to ground G. The private-armature 107 is thereby retained in a depressed condition even after the rotary magnet is deenergized and the side-switch is held in second position. The side-switch-wiper 128 being, therefore, retained in engagement with the grounded contact-point 138, as soon as the interrupter-springs 104 and 105 reengage, the energizing circuit through the rotary-magnet 94 is completed once more. As a result the rotary-armature 97 is again attracted, the shaft rotated one more step, and the private-wiper 41 slides onto the second terminal of the second level of the private-bank. Said second contact also being grounded the energizing circuit through the private-magnet 108 is still maintained, so that the side-switch is still held when the rotary-magnet 94 is again deenergized. Clearly, then, the shaft will be rotated in a step-by-step manner as long as the private-wiper 41 continues to encounter grounded private-contacts. After being rotated onto the ninth contact the private-wiper 41 is rotated one more step into engagement with the tenth contact of the second level of the private-bank; but this last contact being devoid of

guarding potential, the energizing circuit through the private-magnet 108 (which has up to this time maintained the private-magnet energized) is broken. This occurs at just about the time the rotary-armature 97 is at the end of its attractive stroke, so that the private-armature that has up to this time held the side-switch in second position through the medium of the magnetizing force that has now disappeared from the private-magnet falls back as the rotary-armature 97 returns to its normal position. Between the time that the private-armature 107 is released by the private-magnet 108 and the time that the rotary-armature fully regains its normal position the side-switch is permitted to pass to third position. It is then that the side-switch-wipers 128, 129, 130 and 131 leave the contact-points 138, 139, 140 and 141 and pass onto the contact-points 142, 143, 144 and 145. The shifting of the side-switch and, therefore, the disengagement of the side-switch-wiper 128 from the contact-point 138 occurs just before the interrupter-springs 104 and 105 reengage, and then the circuit through the rotary-magnet 94 is permanently broken and no further rotation of the shaft can take place. At the same time the engagement of the side-switch-wiper 129 with contact-point 143 provides the private-wiper with guarding potential to protect the trunk seized by the line-wipers 39 and 40. Having seized this trunk and, therefore, the idle connector C the calling subscriber #100 operates his dial for the second digit 2 of the number 220. Again, as the dial returns to normal position, after having been advanced, the vertical-line-conductor 225 is grounded twice and the rotary-line-conductor 226 once. Grounding the vertical-line-conductor, now that the subscriber's line is extended to the connector C, energizes the connector vertical-line-relay 162. The said vertical-line-conductor being grounded twice the said vertical-line-relay is energized twice and in each case the energizing current passes from the ground terminal G¹ at the sub-station #100 to the ground-post 12 and through the vertical impulse-finger 11 to the vertical-line-conductor 225, thence through the first-selector side-switch-wiper 130 to the contact-point 144 and over the conductor 248, vertical-line-wiper 39 and vertical-trunk-conductor 240 to the vertical-line-relay 162 and thence to the conductor 249 and through the pole-changing-relay-springs 215 and 216 to the battery-lead 233 and to the non-grounded terminal of battery B and to ground G. Being energized twice the vertical-line-relay 162 presses the vertical-line-relay-springs 166 and 167 into contact twice through the medium of the vertical-line-relay-armature 164. An energizing current flows through the line-relay-springs 167 and 166, conduc-

tor 250, private-springs 198 and 197, conductor 251, side-switch-wiper 252, contact-point 253, conductor 254 and vertical-magnet 171 to the conductor 255 and through
 5 the circuit-controlling-relay-springs 218 and 219 to the battery-lead 233 and to the non-grounded terminal of battery B and to ground G. The vertical-magnet upon attracting its armature the first time the said
 10 magnet is energized causes the double-dog 177 to be released at the same time that the switch-shaft 153 is raised, in which raised position it is caught by the said double-dog and held. At the second energization of
 15 the vertical-magnet the shaft 153 is raised a second step and the shaft-wipers 150, 151 and 152 are, therefore, placed opposite the first contacts of the second level of their respective banks 148 and 149. The ground-
 20 ing of the rotary-line-conductor 226, after the shaft has been thus raised, energizes the rotary-line-relay 163 of the connector C, which latter in turn energizes the private-magnet 174 and trips the side-switch to
 25 second position. The energizing circuit through the said rotary-line-relay carries a current from ground G¹ at the sub-station #100 to the ground-post 12 and through the rotary impulse-finger 14 to the
 30 rotary-line-conductor 226, thence through the first-selector side-switch-wiper 131, contact-point 145, conductor 256 and rotary-line-wiper 40 to the rotary-trunk-conductor 241 and through the rotary-line-relay
 35 163 to the battery-lead 233 and to the non-grounded terminal of battery B and to ground G. The rotary-line-relay being thus energized once, by means of its armature 165, presses the line-relay-springs 168 and
 40 167 together and thereby causes an energizing circuit through the private-magnet 174 from ground G⁰ through the line-relay-springs 167 and 168, conductor 257, private-magnet 174, conductors 258 and 259, circuit-
 45 controlling-relay-springs 218 and 219 to the battery-lead 233 and to the non-grounded terminal of battery B and to ground G. The private-magnet by attracting its armature 260 once and releasing the same allows the side-
 50 switch to escape to second position, and the side-switch-wipers 252 and 261 leave the contact-points 253 and 262 and pass onto the contact-points 263 and 264 in a well-known manner. The side-switch-wiper 252
 55 in shifting its position from engagement with the contact-point 253 into engagement with the contact-point 263 changes certain internal circuits in the connector, so that when the vertical-line-conductor 225 is
 60 grounded again the rotary-magnet 173 instead of the vertical-magnet 171 is energized when the line-relay presses the line-relay-springs 166 and 167 into contact. The subscriber at the next step operates the dial
 65 for the last digit and thereby grounds the vertical-line-conductor 225 ten times and immediately after the rotary-line-conductor 226 once. Each time that the said vertical-conductor is grounded the vertical-line-relay 162 of the connector C is energized, as
 70 described, ten times. Each time that the armature 164 is attracted the line-relay-springs 166 and 167 are forced together and the rotary-magnet 173 is energized. The energizing circuit through the said
 75 rotary-magnet 173 extends from ground G², through the line-relay-springs 167 and 166 and private-springs 198 and 197 to the side-switch-wiper 252, through the contact-point 263 and rotary-magnet 173 to the
 80 conductor 255, circuit-controlling-relay-springs 218 and 219 to the battery-lead 233 and to the non-grounded terminal of battery B and to ground G. At each pulsation the rotary-magnet 173 attracts its ar-
 85 mature 187 and rotates the shaft one step. The shaft-wipers 150, 151 and 152 are, therefore, carried one step at a time along the bank level to which they were raised, and are carried by ten steps into engagement
 90 with the tenth contact of the second level of their respective banks 148 and 149. When the rotary-line-conductor 226 is grounded, immediately after the ground impulses are sent over the vertical-line-conductor 225, the
 95 rotary-line-relay 163 of the connector C is energized as before, and as a result the private-magnet 174 is again energized once and the side-switch passes to third position, carrying the side-switch-wipers 252, 261, 265
 100 and 266 into engagement with the contact-points 267, 268, 269 and 270, respectively. The closure of connection between the side-switch-wipers 265 and 266 and the contact-points 269 and 270, respectively, connects
 105 the calling subscriber's extended line-conductors 240 and 241 through the condensers 271 and 272, respectively, and, therefore, with the normal-conductors 273 and 274 that constitute the terminals of the called
 110 line. The engagement of the side-switch-wiper 261 with the contact-point 268 at the same time places a guarding potential at the private-wiper 152 and at the tenth private-
 115 contact of the second level of the private-bank 149 and at all other private-contacts connected in multiple thereto, so as to preclude any other connector from calling in upon the called line #220. The establish-
 120 ment of this guarding potential not only protects the called line from further seizure, but also forces a current through the bridge-cut-off-relay 275 of the first-selector A¹ of the called line #220, whereby the said
 125 bridge-cut-off-relay 275 by means of its armature separates the bridge-cut-off-relay-springs 276, 277 and 278 to destroy a normally established bridge connection between the said normal-conductors 273 and 274, through the vertical and rotary line-relays
 130

279 and 280 of the called first-selector A¹, and through the said bridge-cut-off-relay-springs. One of the main objects in thus disconnecting the said line-relays is to prevent any interference that might otherwise result when ringing current is sent over the called line for signaling. The energizing circuit through the said bridge-cut-off-relay 275 extends from the ground terminal G' at the connector side-switch to the contact-point 268, side-switch-wiper 261, private-wiper 152 and private-normal-conductor 281, and through the switch-shaft-springs 282 and 283 to the bridge-cut-off-relay 275 and thence to the battery-lead 233 and to the non-grounded terminal of battery B and to ground G. Connection between the calling and called line having been established the calling subscriber is in a position to signal the called line by pressing his signaling or ringing-button 31. But before proceeding it may be explained that if for any reason the called line is busy at the time that the calling subscriber grounds the rotary-line-conductor 226 for the last time, as explained, to transfer the connector side-switch from second to third position, and to complete the connection, the connector C is thereby released. For instance, if the line #220 has been called by any connector there will be a guarding potential at the tenth private contact of the second level of the private-bank 149 corresponding to the line of the sub-station #220. Or, on the other hand, if the first-selector A¹ of the called line is being used the said private-contact will be connected to ground from the instant that the switch-shaft is raised one step. Said guarding potential will reach the connector private-bank 149 by way of the private-normal-conductor 281. At any rate if the private-wiper 152 finds a guarding potential at the tenth contact of the second level of the private-bank 149, when the calling subscriber grounds his rotary-line-conductor 226 for the last time, instead of the side-switch being tripped to third position the connector will be released. This occurs because the private-magnet 174 upon becoming energized, as the final result of the calling subscriber grounding his rotary-line-conductor 226, completes an energizing circuit through the release-magnet 172 of the connector when the armature 260 of said private-magnet 174 forces the private-springs 199 and 200 into contact. The energizing circuit for the release-magnet 172 during the busy release extends from the ground terminal G of battery B to the tenth contact of the second level of the connector private-bank 149 through the private-wiper 152, conductor 284, side-switch-wiper 261, contact-point 264, conductor 285, private-springs 199 and 200, conductors 286 and 287 to the release-magnet 172, thence over the conductor 259 and circuit-controlling-springs 218 and 219 to the non-grounded terminal of battery B and to ground G. The connector release-magnet 172 being energized the release-armature 175 strikes the double-dog 177 to the right of the bearings, so that the lug 180 is caught and held in the aperture on the end of the release-link. As a result the switch-shaft 153 is left free to rotate under the influence of the coiled spring 158, which rotation ceases only when the normal-post-arm 157 strikes the normal-post 159. At that instant the shaft-support 161 merges into the slot 160 and the shaft of necessity falls to normal position. When the release-armature 175 rotates the double-dog 177, as stated, it at the same time drives the side-switch to first position, moving it about the pivots 289 of the latter, by means of the link 202 and the release-arm 201. The latter, by pressing the former back, forces the escapement-finger 194 back between the escapement-springs 290 and 291, which finger is then caught behind the rearmost lower tooth 192 and retained there until the connector is used again. It will be noticed that the restoration of the switch-shaft begins even while the release-magnet 172 is energized; but since the energizing circuit through said release-magnet comprises the private-wiper 152 and side-switch-wiper 261, it is evident that when the shaft rotates back toward normal position, and when the side-switch-wiper 261 is forced away from the contact-point 264, the energizing circuit will then be destroyed at two points, at which time the connector release-armature regains its normal position. The calling subscriber thinking that he has established connection presses the signaling-button 31, with the result that the vertical-line-conductor 225 is grounded. This produces, of course, an energization of the connector vertical-line-relay 162 in the usual manner; and since the connector side-switch is in first position the relay 162 produces in turn the energizing of the vertical-magnet 171, through a circuit that is already familiar, when the line-relay-springs 166 and 167 are pressed into contact. The ground connection between the vertical-line-conductor 225 and the ground terminal G¹, when the signaling-button 31 is pressed, is completed through the ground-springs 24 and 25, conductor 292, contact-point 34, signaling-button-spring 32, springs 20 and 19, and springs 17 and 18 to the vertical-line-conductor 225. The vertical-line-relay 162 of the connector C being energized the vertical-magnet 171 is energized as a result and the shaft is raised so that the springs which it controls through the medium of the normal-post-arm are brought into contact. When the said springs 293 and 294 come into contact a

busy signaling circuit is established through the receiver 7 of the calling subscriber #100. A busy signaling current that is induced, for instance, in a secondary winding 295 of the induction-coil 296 passes from said coil 295 through the switch-shaft-springs 293 and 294 to the contact-point 297 of the connector side-switch and through the side-switch-wiper 266, ringer-relay-springs 207 and 209, conductor 298, condenser 272, rotary-trunk-conductor 241, rotary-line-wiper 40 of the first-selector A, conductor 256, contact-point 145, side-switch-wiper 131, rotary-line-conductor 226, primary winding 299 of the induction-coil 300 and transmitter 301 to the vertical-line-conductor 225, first-selector side-switch-wiper 130, contact-point 144, conductor 248, vertical-line-wiper 39, vertical-trunk-conductor 240, vertical-line-relay 162, pole-changing-relay-springs 215 and 216 to the battery-lead 233, and back to the coil 295. The calling subscriber #100 learning, therefore, that the desired line is busy will then restore the receiver 7 to the switch-hook, grounding the vertical and rotary line-conductors 225 and 226 simultaneously. This is done when the release-cam 4 forces the release-springs 28, 29 and 30 into contact. The connection from ground G^1 to the vertical-line-conductor 225 comprises the ground-springs 24 and 25, conductor 292, ground-release-spring 30, vertical-release-spring 29, which latter is connected to the vertical-line-conductor 225. The ground connection to the rotary-line-conductor 226 is established from the said ground G^1 through the ground-springs 24 and 25 to the ground-release-spring 30, thence through the springs 29 and 28 to the rotary-line-conductor 226. Both of the line-conductors being grounded at the same time the vertical and rotary line-relays 162 and 163 of the connector are energized at the same time, and as a result the trunk-release-springs 169 and 170 are brought into contact and an energizing circuit is thereby established through the connector release-magnet 172 and the first-selector back-release-relay 67. The energizing current in this case passes from ground G^1 at the first-selector side-switch to the contact-point 143, side-switch-wiper 129, back-release-relay 67, private-wiper 41, trunk-release-conductor 302, trunk-release-springs 169 and 170, release-magnet 172, circuit-controlling-relay-springs 218 and 219 to the battery-lead 233 and to the non-grounded terminal of battery B and to ground G. The connector release-magnet 172 upon attracting its armature 175 causes the connector switch-shaft to be restored. At the same time that the connector release-magnet 172 is magnetized the first-selector back-release-relay attracts its armature 68 and forces the back-release-relay-springs 69 and 70 into contact, and as a result the first-

selector release-magnet 84 is energized also. The energizing circuit through the said first-selector release-magnet 84, thus established, permits energizing current to flow from the ground terminal G^8 through the back-release-relay-springs 69 and 70 to the release-magnet 84, thence to the non-grounded terminal of battery B and to ground G. The release-magnet 84 then attracts its armature, thrusting the release-link forward and latching the double dog therewith. When the subscriber's switch-hook 2 descends sufficiently to allow the release-springs 28, 29 and 30 to again separate, the energizing circuits through the connector line-relays 162 and 163 are then interrupted, and as a result the circuit established with the connector release-magnet 172 and first-selector back-release-relay 67 in series is destroyed; and at the same time the first-selector release-magnet 84 is deenergized, at which time the said switch A is fully restored. It is seen, therefore, that by the operation of restoring the switch-hook 2 the calling subscriber, after he has received a busy signal, may return all of the central office apparatus that he has brought into use to normal position. But if the calling subscriber does not find the line busy and the connection over said line is completed, as previously described, by pressing the signaling-button 31 he signals the called subscriber. Grounding the vertical-line-conductor 225 by operating his signaling-button 31 causes the connector vertical-line-relay 162 to be energized, and as a result, since the connector side-switch is in third position and since the side-switch-wiper 252 is therefore in engagement with the contact-point 267, the ringer-relay 204 is energized. The energizing current passes from the ground terminal G^8 through the line-relay-springs 167 and 166 to the side-switch-wiper 252, thence to the contact-point 267 and through the ringer-relay 204, circuit-controlling-relay-springs 218 and 219 to the battery-lead 233 and to the non-grounded terminal of battery B and to ground G. The ringer-relay 204 upon attracting its armature 205 forces the ringer-relay-springs 206 and 207 away from the normally engaging springs 208 and 209 and onto the ringer-generator-springs 210 and 211. The signaling current then passes onto the called subscriber's line from the ringer-generator 212, through the ringer-relay-springs 211 and 207, side-switch-wiper 266, contact-point 270, conductor 303, rotary-line-wiper 150, rotary-normal-conductor 274, rotary-line-conductor 304, condenser 305, ringer 306, spring 307, switch-hook 308, vertical-line-conductor 309, vertical-normal-conductor 273, vertical-line-wiper 151, conductor 310, contact point 269, side-switch-wiper 265 and ringer-relay-springs 206 and 210 to the ringer-generator 212. The sub-

scriber at the sub-station #220 upon hearing the signal removes his receiver 311 from the switch-hook 308, thereby removing his ringer 306 from across the line and substituting instead the transmitter 312 and the primary winding 313 of the induction-coil 314. At the instant that the transmitter 312 is thrown across the line the line-conductors 304 and 309 of the called line #220 are connected together through the said transmitter and an energizing circuit is established, whereby the pole-changing-relay 213 and the circuit-controlling-relay 214 at the connector are magnetized. As soon as the circuit-controlling-relay 214 becomes energized the springs 218 and 219 are forced apart and as a result the ringer-relay 204 and the release-magnet 172, the rotary-magnet 173, the vertical-magnet 171 and the private-magnet 174 are disconnected from the battery-lead 233 and thus rendered inoperative. The pole-changing-relay 213 upon attracting its armature shifts the spring 215 from connection with the non-grounded terminal of the battery B and into connection with the grounded terminal of battery B and current is thereby provided to the transmitter of the calling sub-station #100 for talking purposes. The current in the energizing circuit for the pole-changing and circuit-controlling relays 213 and 214 flows from the ground terminal G¹ at the connector side-switch to the contact-point 268, side-switch-wiper 261, springs 224 and 225^a, relay 214, conductor 315, ringer-relay-springs 208 and 206, side-switch-wiper 265, vertical-line-wiper 151, vertical-normal-conductor 273, vertical-line-conductor 309, through the springs 316 and 317, and the springs 318 and 319, transmitter 312, primary winding 313 of the induction-coil 314 to the rotary-line-conductor 304, thence to the rotary-normal-conductor 274, rotary-line-wiper 150, side-switch-wiper 266, ringer-relay-springs 207 and 209, conductor 298 and pole-changing-relay 213 to the non-grounded terminal of battery B and to ground G. The energizing circuit for the transmitter at the calling sub-station #100 enables current to flow from ground G² through the pole-changing-relay-springs 217 and 215, vertical-line-relay 162, vertical-trunk-conductor 240, vertical-line-wiper 39, of the first-selector A, side-switch-wiper 130, vertical-line-conductor 225, springs 18 and 17, and springs 19 and 20, signaling circuit spring 32, contact-point 33, transmitter 301, primary winding 299 of the induction-coil 300, rotary-line-conductor 226, side-switch-wiper 131 of the first-selector A, rotary-line-wiper 40, rotary-trunk-conductor 241, rotary-line-relay 163 to the non-grounded terminal of battery B and to ground G. It will be noticed that the energizing current in this preceding circuit passes through the vertical and rotary line-relays 162 and 163 which are thereby energized, and as a result the trunk-release-springs 169 and 170 are brought into contact, but since the circuit-controlling-relay 214 is energized the energizing circuit that ordinarily would be set up through the connector release-magnet 172 and first-selector back-release-relay 67 in series is maintained opened by the said circuit-controlling-relay 214. Said circuit-controlling-relay having been once energized the release of the switching apparatus cannot take place until after said relay is deenergized, for obvious reasons. Attention is also called to the fact that the line-relay-springs 166 and 168 being kept against the ground-spring 167 both windings 221 and 222 of the differential-relay 220 are energized. Through the winding 221 a current flows from ground G³ through the springs 167 and 166 to said winding 221 and thence to the non-grounded terminal of battery B and through the other winding 222 the current flows from ground G³, through the springs 167 and 168 to the coil 222 and thence to the non-grounded terminal of battery B. This relay, however, as explained, when thus energized does not attract its armature 223. The two subscribers being thus connected, and their transmitters 301 and 312 being in series with the primary windings 299 and 313 of their respective induction-coils 300 and 314, and provided with talking current, and their receivers 7 and 311 being connected in series with the secondary windings 320 and 321 of their allotted induction-coils 300 and 314, the two subscribers in a manner well-known to those skilled in the art may now communicate with each other. Connection having been established, if the called subscriber restores his receiver 311 to the switch-hook the ringer 306 is restored across the line and the transmitter circuit is removed from across the line from the instant that the springs 316 and 317, and 318 and 319 are forced apart. Thus the circuit-controlling and pole-changing relays 214 and 213 are restored and as a result the energizing current for the transmitter 301 at the calling sub-station is cut off and at the same time the operative magnets of the connector C are restored into connection with the non-grounded terminal of battery B. Then if the calling subscriber restores his receiver 7 he will ground both line-conductors 225 and 226 and thereby energize the vertical and rotary line-relays 162 and 163 of the connector; and as a result the connector release-magnet 172 and first-selector back-release-relay 67 (which latter relay in turn energizes the first-selector release-magnet 84) are all energized in the manner already described. This release is similar to the re-

lease described after the subscriber received the busy signal, the only difference being that the connector-switch-shaft 38 is rotated and must first return to normal rotary position before it falls to normal vertical position. If, however, the calling subscriber restores his receiver first the release-circuits are different. As the switch-hook descends the cam-arm 5 engages the ringer circuit spring 15 and forces the springs 17 and 18 apart and destroys the circuit that provides the transmitter 301 with current, which circuit while established maintains the vertical and rotary line-relays 162 and 163 of the connector C energized, and as a result the said line-relays are de-magnetized. As the switch-hook is lowered the ground-release-spring 30 is forced onto the vertical-line-release-spring 29 by the cam 4 and at once the vertical-line-relay 162 is energized over well-known circuits. As soon as the spring 166 is forced onto the spring 167 a current passes through the winding 221 of the differential-relay 220, which relay then attracts its armature 223 and restores the circuit-controlling-relay 214 and the pole-changing-relay 213, since the energizing circuit for these relays is controlled by the springs 224 and 225^a allotted to the differential-relay 220. At once the connector operative magnets are restored into connection with the non-grounded terminal of the battery B, and immediately after the switch-hook, having descended sufficiently, also grounds the rotary-line-conductor 226 and thereby energizes the rotary-line-relay 163 at the same time that the vertical-line-relay 162 is energized. As a result an energizing circuit is established through the connector release-magnet 172 and the first-selector back-release-relay 67 that will restore the switches. It will be evident that while the calling subscriber is making a call, and each time that the vertical or rotary line-relays of the connector C are energized singly, the differential-relay 220 is energized also; but the energizing of said relay before the called subscriber has answered produces no effect of consequence. It will be noticed, furthermore, that during the release just described that takes place while the two subscribers' lines are provided with talking current, as soon as the rotary-line-relay 163 becomes energized, after the vertical-line-relay 162 has been energized, current will pass through the other side 222 of the differential-relay 220 and neutralize the latter; but the energizing of the connector release-magnet 172 and the first-selector back-release-relay 67 takes place so quickly when the trunk-release-springs 169 and 170 come into contact that the switches are restored before the armature of the said differential-relay 223 has had time to restore the springs 224

and 225^a under its control, and before the circuit-controlling-relay 214 has had time to become re-energized.

Thus the central battery provides current for energizing the transmitters of the sub-stations, but said energizing current is not provided at either sub-station until after the called subscriber has answered. Furthermore, a special relay is provided (the differential-relay 220) to enable the calling subscriber to release the instruments after he has made a call and, therefore, while the operative magnets of the connector are disconnected from the non-grounded terminal of battery B. It will be evident that in such a system the exchanges may be made to accommodate ten thousand subscribers if desired, in which case second-selector-switches would be used and in any established connection, such as the one shown in Fig. 1. The second-selector would be located between the first-selector A and the connector C, as shown in Fig. 3. The second-selector is identical with the first-selector A, save that the bridge-cut-off-relay 62 is removed, and, furthermore, no normal-conductors such as the conductors 244, 245 and 246 are provided, but instead from the spring 322 (similar to the back-release-relay-spring 69 of the first-selector A) a third or trunk-release-conductor 323 extends to the first-selector private bank-contacts 324, just as the third trunk-release-conductor 302 is connected from the connector to the first-selector-banks. With the second-selector in circuit during a release, the connector line-relays 162 and 163 would close connection between the trunk-release-springs 169 and 170, as shown in Fig. 1, and thereby energize the connector release-magnet 172 in series with the second-selector back-release-relay 325, which relay in turn energizes the second-selector release-magnet 326 and first-selector back-release-relay 67 in series. The first-selector back-release-relay 67 would energize the first-selector release-magnet, as is well known.

During conversation and during the temporary establishment of the talking circuit between any two subscribers, the line-relays of the connector constitute the sole resistance for bridging the battery across the said circuit at the calling side of the condensers—that is to say, for bridging the battery across the circuit at the right of the condensers 271 and 272 (Fig. 2). It will be understood, of course, that other suitable inductive connections may be substituted for these condensers, for the broader purposes of my invention, and according to the requirements of different cases. At such time the circuit-controlling-relay 214 and the pole-changing-relay 213 constitute the only resistance for bridging the battery across the talking cir-

cuit at the called side of the said condensers. In this way, there will be only two relay windings in the circuit for charging the calling subscriber's transmitter, and in a similar way there will only be two relay windings in the circuit for charging the called subscriber's transmitter. The differential-relay of the connector has a local energizing circuit, as described, controlled by one of the line-relays. The sub-station devices for operating the releasing means of the connector comprise means for first opening the talking circuit, means for then grounding one side of the circuit, and means for finally grounding both sides of the circuit. It will be seen that these three steps are all necessary when the calling subscriber releases, but that only the first step is necessary when the called subscriber releases. The called subscriber can, of course, de-energize the circuit-controlling-relay 214 by simply opening the line-circuit; but the calling subscriber can only accomplish this operation through the medium of the differential-relay of the connector, and hence the necessity of the three operations when the calling subscriber releases.

The connectors herein referred to, and in connection with which I have elected to illustrate my invention, may be of the general type disclosed in Patent No. 815,176, issued March 13, 1906, to Keith, Erickson and Erickson.

It will be understood, of course, that the resistance of the various relays and electromagnets can be readily adjusted to suit requirements and with a view to obtaining the described method of operation. For example, I have obtained good results by using relays and magnets having their resistance adjusted as follows: The rotary and vertical line-relays 163 and 162 500 ohms each; the vertical-magnet 171 60 ohms; the rotary-magnet 173 60 ohms; the private-magnet 174 350 ohms; the differential-relay windings 221 and 222 500 ohms each; the release-magnet 172 60 ohms; and the back-release-relay 67 of the first-selector $\frac{1}{2}$ ohm. The battery may be of 50 volts.

The relays 162 and 163, and 214 and 213 have sufficient resistance to regulate the supply of talking current to the sub-stations. In addition, these four relays have sufficient self induction to enable them to act as impedance-coils for preventing the passage of voice-currents through the battery which is bridged across the talking circuit during conversation.

What I claim as my invention is:—

1. In a telephone system, the combination of a temporarily established talking circuit extending between calling and called subscribers' sub-stations, a condenser in each side of said circuit, a centralized source of talking and switching current, subscriber-

controlled automatic switching machinery temporarily retained in position to maintain the circuit for talking purposes, said switching machinery provided with a pair of line-relays controllable only by the calling subscriber, the two windings of which constitute the only resistance for bridging the source of current across the talking circuit at the calling side of said condensers, auxiliary circuits controlled by said relays, another pair of relays controllable by the called subscriber, the windings of which constitute the only resistance for bridging the source of current across the talking circuit at the called side of said condensers, auxiliary circuits controlled by said last-mentioned pair of relays, and a fifth relay by which the calling subscriber controls the flow of current to that part of the talking circuit allotted to the called sub-station.

2. In a telephone system, the combination of a temporarily established talking circuit extending between calling and called subscribers' sub-stations, a condenser in each side of said circuit, a centralized source of talking and switching current, subscriber-controlled automatic switching machinery temporarily retained in position to maintain the circuit for talking purposes, said switching machinery provided with a pair of line-relays controllable only by the calling subscriber, the two windings of which constitute the only resistance for bridging the source of current across the talking circuit at the calling side of said condensers, auxiliary circuits controlled by said relays, another pair of relays controllable by the called subscriber, the windings of which constitute the only resistance for bridging the source of current across the talking circuit at the called side of said condensers, auxiliary circuits controlled by said last-mentioned pair of relays, and a differentially-wound relay by which the calling subscriber controls the flow of current to that part of the talking circuit allotted to the called sub-station.

3. In a telephone system, the combination of a temporarily established talking circuit extending between calling and called subscribers' sub-stations, a condenser in each side of said circuit, a centralized source of talking and switching current, subscriber-controlled automatic switching machinery temporarily retained in position to maintain the circuit for talking purposes, said switching machinery provided with a pair of line-relays controllable only by the calling subscriber, the two windings of which constitute the only resistance for bridging the source of current across the talking circuit at the calling side of said condensers, auxiliary circuits controlled by said relays, another pair of relays controllable by the called subscriber, the windings of which

constitute the only resistance for bridging the source of current across the talking circuit at the called side of said condensers, auxiliary circuits controlled by said last-mentioned pair of relays, and a fifth relay by which the calling subscriber controls the flow of current to that part of the talking circuit allotted to the called sub-station, said fifth relay having two windings adapted to neutralize each other when energized in parallel.

4. In a telephone system, the combination of a temporarily established talking circuit extending between calling and called subscribers' sub-stations, a condenser in each side of said circuit, a centralized source of talking and switching current, subscriber-controlled automatic switching machinery temporarily retained in position to maintain the circuit for talking purposes, said switching machinery provided with a pair of line-relays controllable only by the calling subscriber, the two windings of which constitute the only resistance for bridging the source of current across the talking circuit at the calling side of said condensers, auxiliary circuits controlled by said relays, another pair of relays controllable by the called subscriber, the windings of which constitute the only resistance for bridging the source of current across the talking circuit at the called side of said condensers, auxiliary circuits controlled by said last-mentioned pair of relays, and a fifth relay by which the calling subscriber controls the flow of current to that part of the talking circuit allotted to the called sub-station, together with a trunk-release-circuit jointly controlled by said line-relays and one of said second pair of relays.

5. In a telephone system, the combination of a temporarily established talking circuit extending between calling and called subscribers' sub-stations, a condenser in each side of said circuit, a centralized source of talking and switching current, subscriber-controlled automatic switching machinery temporarily retained in position to maintain the circuit for talking purposes, said switching machinery provided with a pair of line-relays controllable only by the calling subscriber, the two windings of which constitute the only resistance for bridging the source of current across the talking circuit at the calling side of said condensers, auxiliary circuits controlled by said relays, another pair of relays controllable by the called subscriber, the windings of which constitute the only resistance for bridging the source of current across the talking circuit at the called side of said condensers, auxiliary circuits controlled by said last-mentioned pair of relays, and a fifth relay by which the calling subscriber controls the

flow of current to that part of the talking circuit allotted to the called sub-station, together with an energizing circuit for said fifth relay, said energizing circuit controlled by one of said line-relays.

6. In a telephone system, the combination of a temporarily established talking circuit extending between calling and called subscribers' sub-stations, a condenser in each side of said circuit, a centralized source of talking and switching current, subscriber-controlled automatic switching machinery temporarily retained in position to maintain the circuit for talking purposes, said switching machinery provided with a pair of line-relays controllable only by the calling subscriber, the two windings of which constitute the only resistance for bridging the source of current across the talking circuit at the calling side of said condensers, auxiliary circuits controlled by said relays, another pair of relays controllable by the called subscriber, the windings of which constitute the only resistance for bridging the source of current across the talking circuit at the called side of said condensers, auxiliary circuits controlled by said last-mentioned pair of relays, and a fifth relay by which the calling subscriber controls the flow of current to that part of the talking circuit allotted to the called sub-station, one of said second pair of relays provided with means for controlling the flow of talking current to the calling subscriber's sub-station.

7. In a telephone system, the combination of a temporarily established talking circuit extending between calling and called subscribers' sub-stations, a condenser in each side of said circuit, a centralized source of talking and switching current, subscriber-controlled automatic switching machinery temporarily retained in position to maintain the circuit for talking purposes, said switching machinery provided with a pair of line-relays controllable only by the calling subscriber, the two windings of which constitute the only resistance for bridging the source of current across the talking circuit at the calling side of said condensers, auxiliary circuits controlled by said relays, another pair of relays controllable by the called subscriber, the windings of which constitute the only resistance for bridging the source of current across the talking circuit at the called side of said condensers, auxiliary circuits controlled by said last-mentioned pair of relays, and a differentially-wound relay by which the calling subscriber controls the flow of current to that part of the talking circuit allotted to the called sub-station, one of said second pair of relays provided with means for controlling the flow of talking current to the calling subscriber's sub-station.

8. In a telephone system, the combination of a temporarily established talking circuit extending between calling and called subscribers' sub-stations, a condenser in each side of said circuit, a centralized source of talking and switching current, subscriber-controlled automatic switching machinery temporarily retained in position to maintain the circuit for talking purposes, said switching machinery provided with a pair of line-relays controllable only by the calling subscriber, the two windings of which constitute the only resistance for bridging the source of current across the talking circuit at the calling side of said condensers, auxiliary circuits controlled by said relays, another pair of relays controllable by the called subscriber, the windings of which constitute the only resistance for bridging the source of current across the talking circuit at the called side of said condensers, auxiliary circuits controlled by said last-mentioned pair of relays, and a fifth relay by which the calling subscriber controls the flow of current to that part of the talking circuit allotted to the called sub-station, said fifth relay having two windings adapted to neutralize each other when energized in parallel, one of said second pair of relays provided with means for controlling the flow of talking current to the calling subscriber's sub-station.

9. In a telephone system, the combination of a temporarily established talking circuit extending between calling and called subscribers' sub-stations, a condenser in each side of said circuit, a centralized source of talking and switching current, subscriber-controlled automatic switching machinery temporarily retained in position to maintain the circuit for talking purposes, said switching machinery provided with a pair of line-relays controllable only by the calling subscriber, the two windings of which constitute the only resistance for bridging the source of current across the talking circuit at the calling side of said condensers, auxiliary circuits controlled by said relays, another pair of relays controllable by the called subscriber, the windings of which constitute the only resistance for bridging the source of current across the talking circuit at the called side of said condensers, auxiliary circuits controlled by said last-mentioned pair of relays, and a fifth relay by which the calling subscriber controls the flow of current to that part of the talking circuit allotted to the called sub-station, one of said last-mentioned pair of relays provided with means for shifting or transposing the winding of one of the line-relays from one pole of said source of current to the other.

10. In a telephone system, the combination of a pair of line-relays, a third relay, release mechanism, a trunk-release-circuit

conjointly controlled by said three relays, a differential-relay, an energizing circuit for said third relay, controlled by said differential-relay, and a local energizing circuit for said differential-relay.

11. In a telephone system, the combination of a pair of line-relays, a third relay, release mechanism, a trunk-release-circuit conjointly controlled by said three relays, a differential-relay, an energizing circuit for said third relay, controlled by said differential-relay, and a local energizing circuit for said differential-relay, controlled by one of said line-relays.

12. In a telephone system, the combination of a pair of line-relays, a third relay, release mechanism, a trunk-release-circuit conjointly controlled by said three relays, a differential-relay, an energizing circuit for said third relay, controlled by said differential-relay, and an energizing circuit for said differential-relay, controlled by one of said line-relays.

13. In a telephone system, the combination of a talking circuit, a connector provided with a release mechanism, a release-magnet, a release-relay, an energizing circuit for said release-relay, including a portion of said talking circuit, a differential-relay controlling said energizing circuit, and a local circuit for energizing said differential-relay.

14. In a telephone system, the combination of a talking circuit, a connector provided with a release mechanism, a release-magnet, a release-relay, an energizing circuit for said release-relay, including a portion of said talking circuit, a differential-relay controlling said energizing circuit, and a local circuit for energizing said differential-relay, together with a line-relay controlling said local circuit.

15. In a telephone system, the combination of a talking circuit, a connector provided with a release mechanism, a release-magnet, a release-relay, an energizing circuit for said release-relay, including a portion of said talking circuit, a differential-relay controlling said energizing circuit, and a local circuit for energizing said differential-relay, together with a line-relay controlling said local circuit, and a trunk-release-circuit controlled by said line-relay and release-relay.

16. In a telephone system, the combination of a trunk-release-circuit, line and release relays conjointly controlling said circuit, a line-circuit for energizing the release-relay, an additional relay for controlling said line-circuit, and a local circuit for energizing said additional relay.

17. In a telephone system, the combination of a talking circuit, a connector provided with a pair of line-relays, a differential-relay, parallel local circuits for the

windings of said differential relay, controlled by said line-relays, closed when the latter are energized, and a circuit controlled by said differential relay.

18. In a telephone system, the combination of a talking circuit, a connector provided with a pair of line-relays, a differential-relay, parallel local circuits for the windings of said differential-relay, controlled by said line-relays, closed when the latter are energized, and a circuit controlled by said differential-relay, including a portion of said talking circuit.

19. In a telephone system, the combination of a talking circuit, a connector provided with a release mechanism, a release-magnet, a release-relay, an energizing circuit for said release-relay, including a portion of said talking circuit, a differential-relay controlling said energizing circuit, and a local circuit for energizing said differential-relay, said connector being also provided with a busy release circuit controlled by said release-relay.

20. In a telephone system, the combination of a talking circuit, a connector provided with a release mechanism, a release-magnet, a release-relay, an energizing circuit for said release-relay, including a portion of said talking circuit, a differential-relay controlling said energizing circuit, and a local circuit for energizing said differential-relay, together with a line-relay controlling said local circuit, said connector being also provided with a busy release circuit controlled by said release-relay.

21. In a telephone system, the combination of a talking circuit, a connector provided with a release mechanism, a release-magnet, a release-relay, an energizing circuit for said release-relay, including a portion of said talking circuit, a differential-relay controlling said energizing circuit, a local circuit for energizing said differential-relay, together with a line-relay controlling said local circuit, and a trunk-release-circuit controlled by said line-relay and release-relay, said connector being also provided with a busy release circuit controlled by said release-relay.

22. In a telephone system, the combination of a talking circuit, a connector provided with a pair of line-relays, a differential-relay, parallel local circuits for the windings of said differential-relay, controlled by said line-relays, closed when the latter are energized, a circuit controlled by said differential-relay, said connector being also provided with a busy release circuit, and electro-magnets conjointly controlling said busy release circuit.

23. In a telephone system, the combination of a talking circuit, a connector provided with a pair of line-relays, a differential-relay, parallel local circuits for the

windings of said differential-relay, controlled by said line-relays, closed when the latter are energized, a circuit controlled by said differential-relay, including a portion of said talking circuit, said connector being also provided with a busy release circuit, and electro-magnets conjointly controlling said busy release circuit.

24. In a telephone system, the combination of a talking circuit, a connector provided with a pair of line-relays, a differential-relay, parallel local circuits for the windings of said differential-relay, controlled by said line-relays, closed when the latter are energized, a circuit controlled by said differential-relay, said connector being also provided with a busy release circuit, normally open and normally closed switch-points in said busy release circuit, and electro-magnets for operating said switch-points and thereby conjointly controlling said busy release circuit.

25. In a telephone system, the combination of a talking circuit, a connector provided with a pair of line-relays, a differential-relay, parallel local circuits for the windings of said differential-relay, controlled by said line-relays, closed when the latter are energized, a circuit controlled by said differential-relay, including a portion of said talking circuit, said connector being also provided with a busy release circuit, normally open and normally closed switch-points in said busy release circuit, and electro-magnets for operating said switch-points and thereby conjointly controlling said busy release circuit.

26. In a telephone system, the combination of a battery having one pole grounded, a connector provided with a differential-relay having both of its windings permanently connected with the non-grounded pole of said battery, means for connecting the other terminals of said windings with the grounded pole of the battery, and a release circuit controlled by said differential-relay.

27. In a telephone system, the combination of a battery having one pole grounded, an automatic switch provided with a double-wound relay having both of its windings permanently connected with the non-grounded pole of said battery, line-relays for connecting the other terminals of the said windings with the other pole of the battery, and switching means controlled by said relay.

28. In a telephone system, the combination of a temporarily established talking circuit extending between calling and called subscribers' substations, a condenser in each side of said circuit, a centralized source of talking and switching current, subscriber-controlled automatic switching machinery temporarily retained in position to maintain

the circuit for talking purposes, said switching machinery provided with a pair of line-relays controllable only by the calling subscriber, the two windings of which constitute the only resistance for bridging the source of current across the talking circuit at the calling side of said condensers, auxiliary circuits controlled by said relays, means controlled by said auxiliary circuits having vertical motion to select a group and rotary motion to connect with the desired line in the selected group, another pair of relays controllable by the called subscriber, the windings of which constitute the only resistance for bridging the source of current across the talking circuit at the called side of said condensers, auxiliary circuits controlled by said last-mentioned pair of relays, and a fifth relay by which the calling subscriber controls the flow of current to that part of the talking circuit allotted to the called substation.

29. In a telephone system, the combination of a temporarily established talking circuit extending between calling and called subscribers' substations, a condenser in each side of said circuit, a centralized source of talking and switching current, subscriber-controlled automatic switching machinery temporarily retained in position to maintain the circuit for talking purposes, said switching machinery provided with a pair of line-relays controllable only by the calling subscriber, the two windings of which constitute the only resistance for bridging the source of current across the talking circuit at the calling side of said condensers, auxiliary circuits controlled by said relays, means controlled by said auxiliary circuits having vertical motion to select a group and rotary motion to connect with the desired line in the selected group, another pair of relays controllable by the called subscriber, the windings of which constitute the only resistance for bridging the source of current across the talking circuit at the called side of said condensers, auxiliary circuits controlled by said last-mentioned pair of relays, and a differentially-wound relay by which the calling subscriber controls the flow of current to that part of the talking circuit allotted to the called substation.

30. In a telephone system, the combination of a temporarily established talking circuit extending between calling and called subscribers' substations, a condenser in each side of said circuit, a centralized source of talking and switching current, subscriber-controlled automatic switching machinery temporarily retained in position to maintain the circuit for talking purposes, said switching machinery provided with a pair of line-relays controllable only by the calling subscriber, the two windings of which constitute the only resistance for bridging

the source of current across the talking circuit at the calling side of said condensers, auxiliary circuits controlled by said relays, means controlled by said auxiliary circuits having vertical motion to select a group and rotary motion to connect with the desired line in the selected group, another pair of relays controllable by the called subscriber, the windings of which constitute the only resistance for bridging the source of current across the talking circuit at the called side of said condensers, auxiliary circuits controlled by said last-mentioned pair of relays, and a fifth relay by which the calling subscriber controls the flow of current to that part of the talking circuit allotted to the called substation, said fifth relay having two windings adapted to neutralize each other when energized in parallel.

31. In a telephone system, the combination of a temporarily established talking circuit extending between calling and called subscribers' substations, a condenser in each side of said circuit, a centralized source of talking and switching current, subscriber-controlled automatic switching machinery temporarily retained in position to maintain the circuit for talking purposes, said switching machinery provided with a pair of line-relays controllable only by the calling subscriber, the two windings of which constitute the only resistance for bridging the source of current across the talking circuit at the calling side of said condensers, auxiliary circuits controllable by said relays, means controlled by said auxiliary circuits having vertical motion to select a group and rotary motion to connect with the desired line in the selected group, another pair of relays controllable by the called subscriber, the windings of which constitute the only resistance for bridging the source of current across the talking circuit at the called side of said condensers, auxiliary circuits controlled by said last-mentioned pair of relays, and a fifth relay by which the calling subscriber controls the flow of current to that part of the talking circuit allotted to the called substation, together with a trunk-release-circuit conjointly controlled by said line-relays and one of said second pair of relays.

32. In a telephone system, the combination of a temporarily established talking circuit extending between calling and called subscribers' substations, a condenser in each side of said circuit, a centralized source of talking and switching current, subscriber-controlled automatic switching machinery temporarily retained in position to maintain the circuit for talking purposes, said switching machinery provided with a pair of line-relays controllable only by the calling subscriber, the two windings of which constitute the only resistance for bridging the

source of current across the talking circuit at the calling side of said condensers, auxiliary circuits controlled by said relays, means controlled by said auxiliary circuits having vertical motion to select a group and rotary motion to connect with the desired line in the selected group, another pair of relays controllable by the called subscriber, the windings of which constitute the only resistance for bridging the source of current across the talking circuit at the called side of said condensers, auxiliary circuits controlled by said last-mentioned pair of relays, and a fifth relay by which the calling subscriber controls the flow of current to that part of the talking circuit allotted to the called substation, together with an energizing circuit for said fifth relay, said energizing circuit controlled by one of said line-relays.

33. In a telephone system, the combination of a temporarily established talking circuit extending between calling and called subscribers' substations, a condenser in each side of said circuit, a centralized source of talking and switching current, subscriber-controlled automatic switching machinery temporarily retained in position to maintain the circuit for talking purposes, said switching machinery provided with a pair of line-relays controllable only by the calling subscriber, the two windings of which constitute the only resistance for bridging the source of current across the talking circuit at the calling side of said condensers, auxiliary circuits controlled by said relays, means controlled by said auxiliary circuits having vertical motion to select a group and rotary motion to connect with the desired line in the selected group, another pair of relays controllable by the called subscriber, the windings of which constitute the only resistance for bridging the source of current across the talking circuit at the called side of said condensers, auxiliary circuits controlled by said last-mentioned pair of relays, and a fifth relay by which the calling subscriber controls the flow of current to that part of the talking circuit allotted to the called substation, one of said second pair of relays provided with means for controlling the flow of talking current to the calling subscriber's substation.

34. In a telephone system, the combination of a temporarily established talking circuit extending between calling and called subscribers' substations, a condenser in each side of said circuit, a centralized source of talking and switching current, subscriber-controlled automatic switching machinery temporarily retained in position to maintain the circuit for talking purposes, said switching machinery provided with a pair of line-relays controllable only by the calling subscriber, the two windings of which consti-

tute the only resistance for bridging the source of current across the talking circuit at the calling side of said condensers, auxiliary circuits controlled by said relays, means controlled by said auxiliary circuits having vertical motion to select a group and rotary motion to connect with the desired line in the selected group, another pair of relays controllable by the called subscriber, the windings of which constitute the only resistance for bridging the source of current across the talking circuit at the called side of said condensers, auxiliary circuits controlled by said last-mentioned pair of relays, and a differentially-wound relay by which the calling subscriber controls the flow of current to that part of the talking circuit allotted to the called substation, one of said second pair of relays provided with means for controlling the flow of talking current to the calling subscriber's substation.

35. In a telephone system, the combination of a temporarily established talking circuit extending between calling and called subscribers' substations, a condenser in each side of said circuit, a centralized source of talking and switching current, subscriber-controlled automatic switching machinery temporarily retained in position to maintain the circuit for talking purposes, said switching machinery provided with a pair of line-relays controllable only by the calling subscriber, the two windings of which constitute the only resistance for bridging the source of current across the talking circuit at the calling side of said condensers, auxiliary circuits controlled by said relays, means controlled by said auxiliary circuits having vertical motion to select a group and rotary motion to connect with the desired line in the selected group, another pair of relays controllable by the called subscriber, the windings of which constitute the only resistance for bridging the source of current across the talking circuit at the called side of said condensers, auxiliary circuits controlled by said last-mentioned pair of relays, and a fifth relay by which the calling subscriber controls the flow of current to that part of the talking circuit allotted to the called substation, said fifth relay having two windings adapted to neutralize each other when energized in parallel, one of said second pair of relays provided with means for controlling the flow of talking current to the calling subscriber's substation.

36. In a telephone system, the combination of a temporarily established talking circuit extending between calling and called subscribers' substations, a condenser in each side of said circuit, a centralized source of talking and switching current, subscriber-controlled automatic switching machinery temporarily retained in position to maintain the circuit for talking purposes, said switching

machinery provided with a pair of line-relays controllable only by the calling subscriber, the two windings of which constitute the only resistance for bridging the source of current across the talking circuit at the calling side of said condensers, auxiliary circuits controlled by said relays, means controlled by said auxiliary circuits having vertical motion to select a group and rotary motion to connect with the desired line in the selected group, another pair of relays controllable by the called subscriber, the windings of which constitute the only resistance for bridging the source of current across the talking circuit at the called side of said condensers, auxiliary circuits controlled by said last-mentioned pair of relays, and a fifth relay by which the calling subscriber controls the flow of current to that part of the talking circuit allotted to the called substation, one of said last-mentioned pair of relays provided with means for shifting or transposing the winding of one of the line-relays from one pole of said source of current to the other.

37. In a telephone system, the combination of a temporarily established talking circuit extending between calling and called subscribers' substations, a condenser in each side of said circuit, a centralized source of talking and switching current, subscriber-controlled automatic switching machinery temporarily retained in position to maintain the circuit for talking purposes, said switching machinery provided with a pair of line-relays controllable only by the calling subscriber, the two windings of which constitute the only resistance for bridging the source of current across the talking circuit at the calling side of said condensers, auxiliary circuits controlled by said relays, means controlled by said auxiliary circuits having vertical motion to select a group and rotary motion to connect with the desired line in the selected group, another pair of relays controllable by the called subscriber, the windings of which constitute the only resistance for bridging the source of current across the talking circuit at the called side of said condensers, auxiliary circuits controlled by said last-mentioned pair of relays, and a fifth relay by which the calling subscriber controls the flow of current to that part of the talking circuit allotted to the called substation, both pairs of relays energized and provided with armatures which remain attracted during conversation.

38. In a telephone system, the combination of a temporarily established talking circuit extending between calling and called subscribers' substations, a condenser in each side of said circuit, a centralized source of talking and switching current, subscriber-controlled automatic switching machinery temporarily retained in position to maintain

the circuit for talking purposes, said switching machinery provided with a pair of line-relays controllable only by the calling subscriber, the two windings of which constitute the only resistance for bridging the source of current across the talking circuit at the calling side of said condensers, auxiliary circuits controlled by said relays, means controlled by said auxiliary circuits having vertical motion to select a group and rotary motion to connect with the desired line in the selected group, another pair of relays controllable by the called subscriber, the windings of which constitute the only resistance for bridging the source of current across the talking circuit at the called side of said condensers, auxiliary circuits controlled by said last-mentioned pair of relays, and a differentially-wound relay by which the calling subscriber controls the flow of current to that part of the talking circuit allotted to the called substation, both pairs of relays energized and provided with armatures which remain attracted during conversation.

39. In a telephone system, the combination of a temporarily established talking circuit extending between calling and called subscribers' substations, a condenser in each side of said circuit, a centralized source of talking and switching current, subscriber-controlled automatic switching machinery temporarily retained in position to maintain the circuit for talking purposes, said switching machinery provided with a pair of line-relays controllable only by the calling subscriber, the two windings of which constitute the only resistance for bridging the source of current across the talking circuit at the calling side of said condensers, auxiliary circuits controlled by said relays, means controlled by said auxiliary circuits having vertical motion to select a group and rotary motion to connect with the desired line in the selected group, another pair of relays controllable by the called subscriber, the windings of which constitute the only resistance for bridging the source of current across the talking circuit at the called side of said condensers, auxiliary circuits controlled by said last-mentioned pair of relays, and a fifth relay by which the calling subscriber controls the flow of current to that part of the talking circuit allotted to the called substation, said fifth relay having two windings adapted to neutralize each other when energized in parallel, both pairs of relays energized and provided with armatures which remain attracted during conversation.

40. In a telephone system, the combination of a temporarily established talking circuit extending between calling and called subscribers' substations, a condenser in each side of said circuit, a centralized source of talking and switching current, subscriber-con-

5 trolled automatic switching machinery temporarily retained in position to maintain the circuit for talking purposes, said switching machinery provided with a pair of line-
 10 relays controllable only by the calling subscriber, the two windings of which constitute the only resistance for bridging the source of current across the talking circuit at the calling side of said condensers, auxiliary circuits controlled by said relays,
 15 means controlled by said auxiliary circuits having vertical motion to select a group and rotary motion to connect with the desired line in the selected group, another pair of relays controllable by the called subscriber, the windings of which constitute the only resistance for bridging the source of current across the talking circuit at the called side of said condensers, auxiliary circuits controlled by said last-mentioned pair of relays,
 20 and a fifth relay by which the calling subscriber controls the flow of current to that part of the talking circuit allotted to the called substation, together with a trunk-release-circuit conjointly controlled by said line-relays and one of said second pair of relays, both pairs of relays energized and provided with armatures which remain attracted during conversation.

30 41. In a telephone system, the combination of a temporarily established talking circuit extending between calling and called subscribers' substations, a condenser in each side of said circuit, a centralized source of talking and switching current, subscriber-
 35 controlled automatic switching machinery temporarily retained in position to maintain the circuit for talking purposes, said switching machinery provided with a pair of line-relays controllable only by the calling subscriber, the two windings of which constitute the only resistance for bridging the source of current across the talking circuit at the calling side of said condensers, auxiliary circuits controlled by said relays, means
 40 controlled by said auxiliary circuits having vertical motion to select a group and rotary motion to connect with the desired line in the selected group, another pair of relays controllable by the called subscriber, the windings of which constitute the only resistance for bridging the source of current across the talking circuit at the called side of said condensers, auxiliary circuits controlled by said last-mentioned pair of relays, and a fifth relay by which the calling subscriber controls the flow of current to that part of the talking circuit allotted to the called substation, together with an energizing circuit for said fifth relay, said energizing circuit controlled by one of said line-relays, both pairs of relays energized and provided with armatures which remain attracted during conversation.

65 42. In a telephone system, the combina-

tion of a temporarily established talking circuit extending between calling and called subscribers' substations, a condenser in each side of said circuit, a centralized source of talking and switching current, subscriber-
 70 controlled automatic switching machinery temporarily retained in position to maintain the circuit for talking purposes, said switching machinery provided with a pair of line-relays controllable only by the calling subscriber, the two windings of which constitute the only resistance for bridging the source of current across the talking circuit at the calling side of said condensers, auxiliary circuits controlled by said relays, means
 75 controlled by said auxiliary circuits having vertical motion to select a group and rotary motion to connect with the desired line in the selected group, another pair of relays controllable by the called subscriber, the windings of which constitute the only resistance for bridging the source of current across the talking circuit at the called side of said condensers, auxiliary circuits controlled by said last-mentioned pair of relays, and a fifth relay by which the calling subscriber controls the flow of current to that part of the talking circuit allotted to the called substation, one of said second pair of relays provided with means for controlling the flow of talking current to the calling subscriber's substation, both pairs of relays energized and provided with armatures which remain attracted during conversation.

100 43. In a telephone system, the combination of a temporarily established talking circuit extending between calling and called subscribers' substations, a condenser in each side of said circuit, a centralized source of talking and switching current, subscriber-
 105 controlled automatic switching machinery temporarily retained in position to maintain the circuit for talking purposes, said switching machinery provided with a pair of line-relays controllable only by the calling subscriber, the two windings of which constitute the only resistance for bridging the source of current across the talking circuit at the calling side of said condensers, auxiliary circuits controlled by said relays, means
 110 controlled by said auxiliary circuits having vertical motion to select a group and rotary motion to connect with the desired line in the selected group, another pair of relays controllable by the called subscriber, the windings of which constitute the only resistance for bridging the source of current across the talking circuit at the called side of said condensers, auxiliary circuits controlled by said last-mentioned pair of relays, and a differentially-wound relay by which the calling subscriber controls the flow of current to that part of the talking circuit allotted to the called substation, one
 120 125 130

of said second pair of relays provided with means for controlling the flow of talking current to the calling subscriber's substation, both pairs of relays energized and provided with armatures which remain attracted during conversation.

44. In a telephone system, the combination of a temporarily established talking circuit extending between calling and called subscribers' substations, a condenser in each side of said circuit, a centralized source of talking and switching current, subscriber-controlled automatic switching machinery temporarily retained in position to maintain the circuit for talking purposes, said switching machinery provided with a pair of line-relays controllable only by the calling subscriber, the two windings of which constitute the only resistance for bridging the source of current across the talking circuit at the calling side of said condensers, auxiliary circuits controlled by said relays, means controlled by said auxiliary circuits having vertical motion to select a group and rotary motion to connect with the desired line in the selected group, another pair of relays controllable by the called subscriber, the windings of which constitute the only resistance for bridging the source of current across the talking circuit at the called side of said condensers, auxiliary circuits controlled by said last-mentioned pair of relays, and a fifth relay by which the calling subscriber controls the flow of current to that part of the talking circuit allotted to the called substation, said fifth relay having two windings adapted to neutralize each other when energized in parallel, one of said second pair of relays provided with means for controlling the flow of talking current to the calling subscriber's substation, both pairs of relays energized and provided with armatures which remain attracted during conversation.

45. In a telephone system, the combination of a temporarily established talking circuit extending between calling and called subscribers' substations, a condenser in each side of said circuit, a centralized source of talking and switching current, subscriber-controlled automatic switching machinery temporarily retained in position to maintain the circuit for talking purposes, said switching machinery provided with a pair of line-relays controllable only by the calling subscriber, the two windings of which constitute the only resistance for bridging the source of current across the talking circuit at the calling side of said condensers, auxiliary circuits controlled by said relays, means controlled by said auxiliary circuits having vertical motion to select a group and rotary motion to connect with the desired line in the selected group, another pair of relays controllable by the called subscriber, the windings of which constitute the only resistance

for bridging the source of current across the talking circuit at the called side of said condensers, auxiliary circuits controlled by said last-mentioned pair of relays, and a fifth relay by which the calling subscriber controls the flow of current to that part of the talking circuit allotted to the called substation, one of said last-mentioned pair of relays provided with means for shifting or transposing the winding of one of the line-relays from one pole of said source of current to the other, both pairs of relays energized and provided with armatures which remain attracted during conversation.

46. In a telephone system, the combination of a temporarily established talking circuit extending between calling and called subscribers' substations, an inductive connection in each side of said circuit, a centralized source of talking and switching current, subscriber-controlled automatic switching machinery temporarily retained in position to maintain the circuit for talking purposes, said switching machinery provided with a pair of line-relays controllable only by the calling subscriber, the two windings of which constitute the only resistance for bridging the source of current across the talking circuit at the calling side of said inductive connections, auxiliary circuits controlled by said relays, means controlled by said auxiliary circuits having vertical motion to select a group and rotary motion to connect with the desired line in the selected group, another pair of relays controllable by the called subscriber, the windings of which constitute the only resistance for bridging the source of current across the talking circuit at the called side of said inductive connections, auxiliary circuits controlled by said last-mentioned pair of relays, and a fifth relay by which the calling subscriber controls the flow of current to that part of the talking circuit allotted to the called substation.

47. In a telephone system, the combination of a temporarily established talking circuit extending between calling and called subscribers' substations, an inductive connection in each side of said circuit, a centralized source of talking and switching current, subscriber-controlled automatic switching machinery temporarily retained in position to maintain the circuit for talking purposes, said switching machinery provided with a pair of line-relays controllable only by the calling subscriber, the two windings of which constitute the only resistance for bridging the source of current across the talking circuit at the calling side of said inductive connections, auxiliary circuits controlled by said relays, means controlled by said auxiliary circuits having vertical motion to select a group and rotary motion to connect with the desired line in the selected group, another pair of relays controllable

by the called subscriber, the windings of which constitute the only resistance for bridging the source of current across the talking circuit at the called side of said inductive connections, auxiliary circuits controlled by said last-mentioned pair of relays, and a differentially-wound relay by which the calling subscriber controls the flow of current to that part of the talking circuit allotted to the called substation.

48. In a telephone system, the combination of a temporarily established talking circuit extending between calling and called subscribers' substations, an inductive connection in each side of said circuit, a centralized source of talking and switching current, subscriber-controlled automatic switching machinery temporarily retained in position to maintain the circuit for talking purposes, said switching machinery provided with a pair of line-relays controllable only by the calling subscriber, the two windings of which constitute the only resistance for bridging the source of current across the talking circuit at the calling side of said inductive connections, auxiliary circuits controlled by said relays, means controlled by said auxiliary circuits having vertical motion to select a group and rotary motion to connect with the desired line in the selected group, another pair of relays controllable by the called subscriber, the windings of which constitute the only resistance for bridging the source of current across the talking circuit at the called side of said inductive connections, auxiliary circuits controlled by said last-mentioned pair of relays, and a fifth relay by which the calling subscriber controls the flow of current to that part of the talking circuit allotted to the called substation, said fifth relay having two windings adapted to neutralize each other when energized in parallel.

49. In a telephone system, the combination of a temporarily established talking circuit extending between calling and called subscribers' substations, an inductive connection in each side of said circuit, a centralized source of talking and switching current, subscriber-controlled automatic switching machinery temporarily retained in position to maintain the circuit for talking purposes, said switching machinery provided with a pair of line-relays controllable only by the calling subscriber, the two windings of which constitute the only resistance for bridging the source of current across the talking circuit at the calling side of said inductive connections, auxiliary circuits controlled by said relays, means controlled by said auxiliary circuits having vertical motion to select a group and rotary motion to connect with the desired line in the selected group, another pair of relays controllable by the called subscriber, the windings of

which constitute the only resistance for bridging the source of current across the talking circuit at the called side of said inductive connections, auxiliary circuits controlled by said last-mentioned pair of relays, and a fifth relay by which the calling subscriber controls the flow of current to that part of the talking circuit allotted to the called substation, together with a trunk-release-circuit conjointly controlled by said line-relays and one of said second pair of relays.

50. In a telephone system, the combination of a temporarily established talking circuit extending between calling and called subscribers' substations, an inductive connection in each side of said circuit, a centralized source of talking and switching current, subscriber-controlled automatic switching machinery temporarily retained in position to maintain the circuit for talking purposes, said switching machinery provided with a pair of line-relays controllable only by the calling subscriber, the two windings of which constitute the only resistance for bridging the source of current across the talking circuit at the calling side of said inductive connections, auxiliary circuits controlled by said relays, means controlled by said auxiliary circuits having vertical motion to select a group and rotary motion to connect with the desired line in the selected group, another pair of relays controllable by the called subscriber, the windings of which constitute the only resistance for bridging the source of current across the talking circuit at the called side of said inductive connections, auxiliary circuits controlled by said last-mentioned pair of relays, and a fifth relay by which the calling subscriber controls the flow of current to that part of the talking circuit allotted to the called substation, together with an energizing circuit for said fifth relay, said energizing circuit controlled by one of said line-relays.

51. In a telephone system, the combination of a temporarily established talking circuit extending between calling and called subscribers' substations, an inductive connection in each side of said circuit, a centralized source of talking and switching current, subscriber-controlled automatic switching machinery temporarily retained in position to maintain the circuit for talking purposes, said switching machinery provided with a pair of line-relays controllable only by the calling subscriber, the two windings of which constitute the only resistance for bridging the source of current across the talking circuit at the calling side of said inductive connections, auxiliary circuits controlled by said relays, means controlled by said auxiliary circuits having vertical motion to select a group and rotary motion to

connect with the desired line in the selected group, another pair of relays controllable by the called subscriber, the windings of which constitute the only resistance for bridging the source of current across the talking circuit at the called side of said inductive connections, auxiliary circuits controlled by said last-mentioned pair of relays, and a fifth relay by which the calling subscriber controls the flow of current to that part of the talking circuit allotted to the called substation, one of said second pair of relays provided with means for controlling the flow of talking current to the calling subscriber's substation.

52. In a telephone system, the combination of a temporarily established talking circuit extending between calling and called subscribers' substations, an inductive connection in each side of said circuit, a centralized source of talking and switching current, subscriber-controlled automatic switching machinery temporarily retained in position to maintain the circuit for talking purposes, said switching machinery provided with a pair of line-relays controllable only by the calling subscriber, the two windings of which constitute the only resistance for bridging the source of current across the talking circuit at the calling side of said inductive connections, auxiliary circuits controlled by said relays, means controlled by said auxiliary circuits having vertical motion to select a group and rotary motion to connect with the desired line in the selected group, another pair of relays controllable by the called subscriber, the windings of which constitute the only resistance for bridging the source of current across the talking circuit at the called side of said inductive connections, auxiliary circuits controlled by said last-mentioned pair of relays, and a differentially-wound relay by which the calling subscriber controls the flow of current to that part of the talking circuit allotted to the called substation, one of said second pair of relays provided with means for controlling the flow of talking current to the calling subscriber's substation.

53. In a telephone system, the combination of a temporarily established talking circuit extending between calling and called subscribers' substations, an inductive connection in each side of said circuit, a centralized source of talking and switching current, subscriber-controlled automatic switching machinery temporarily retained in position to maintain the circuit for talking purposes, said switching machinery provided with a pair of line-relays controllable only by the calling subscriber, the two windings of which constitute the only resistance for bridging the source of current across the talking circuit at the calling side of said inductive connections, auxiliary circuits controlled by said

relays, means controlled by said auxiliary circuits having vertical motion to select a group and rotary motion to connect with the desired line in the selected group, another pair of relays controllable by the called subscriber, the windings of which constitute the only resistance for bridging the source of current across the talking circuit at the called side of said inductive connections, auxiliary circuits controlled by said last-mentioned pair of relays, and a fifth relay by which the calling subscriber controls the flow of current to that part of the talking circuit allotted to the called substation, said fifth relay having two windings adapted to neutralize each other when energized in parallel, one of said second pair of relays provided with means for controlling the flow of talking current to the calling subscriber's substation.

54. In a telephone system, the combination of a temporarily established talking circuit extending between calling and called subscribers' substations, an inductive connection in each side of said circuit, a centralized source of talking and switching current, subscriber-controlled automatic switching machinery temporarily retained in position to maintain the circuit for talking purposes, said switching machinery provided with a pair of line-relays controllable only by the calling subscriber, the two windings of which constitute the only resistance for bridging the source of current across the talking circuit at the calling side of said inductive connections, auxiliary circuits controlled by said relays, means controlled by said auxiliary circuits having vertical motion to select a group and rotary motion to connect with the desired line in the selected group, another pair of relays controllable by the called subscriber, the windings of which constitute the only resistance for bridging the source of current across the talking circuit at the called side of said inductive connections, auxiliary circuits controlled by said last-mentioned pair of relays, and a fifth relay by which the calling subscriber controls the flow of current to that part of the talking circuit allotted to the called substation, one of said last-mentioned pair of relays provided with means, for shifting or transposing the winding of one of the line-relays from one pole of said source of current to the other.

55. In a telephone system, the combination of a temporarily established talking circuit extending between calling and called subscribers' substations, an inductive connection in each side of said circuit, a centralized source of talking and switching current, subscriber-controlled automatic switching machinery temporarily retained in position to maintain the circuit for talking purposes, said switching machinery provided with a

pair of line-relays controllable only by the calling subscriber, the two windings of which constitute the only resistance for bridging the source of current across the talking circuit at the calling side of said inductive connections, auxiliary circuits controlled by said relays, means controlled by said auxiliary circuits having vertical motion to select a group and rotary motion to connect with the desired line in the selected group, another pair of relays controllable by the called subscriber, the windings of which constitute the only resistance for bridging the source of current across the talking circuit at the called side of said inductive connections, auxiliary circuits controlled by said last-mentioned pair of relays, and a fifth relay by which the calling subscriber controls the flow of current to that part of the talking circuit allotted to the called substation, both pairs of relays energized and provided with armatures which remain attracted during conversation.

56. In a telephone system, the combination of a temporarily established talking circuit extending between calling and called subscribers' substations, an inductive connection in each side of said circuit, a centralized source of talking and switching current, subscriber-controlled automatic switching machinery temporarily retained in position to maintain the circuit for talking purposes, said switching machinery provided with a pair of line-relays controllable only by the calling subscriber, the two windings of which constitute the only resistance for bridging the source of current across the talking circuit at the calling side of said inductive connections, auxiliary circuits controlled by said relays, means controlled by said auxiliary circuits having vertical motion to select a group and rotary motion to connect with the desired line in the selected group, another pair of relays controllable by the called subscriber, the windings of which constitute the only resistance for bridging the source of current across the talking circuit at the called side of said inductive connections, auxiliary circuits controlled by said last-mentioned pair of relays, and a differentially-wound relay by which the calling subscriber controls the flow of current to that part of the talking circuit allotted to the called substation, both pairs of relays energized and provided with armatures which remain attracted during conversation.

57. In a telephone system, the combination of a temporarily established talking circuit extending between calling and called subscribers' substations, an inductive connection in each side of said circuit, a centralized source of talking and switching current, subscriber-controlled automatic switching machinery temporarily retained in position to maintain the circuit for talking

purposes, said switching machinery provided with a pair of line-relays controllable only by the calling subscriber, the two windings of which constitute the only resistance for bridging the source of current across the talking circuit at the calling side of said inductive connections, auxiliary circuits controlled by said relays, means controlled by said auxiliary circuits having vertical motion to select a group and rotary motion to connect with the desired line in the selected group, another pair of relays controllable by the called subscriber, the windings of which constitute the only resistance for bridging the source of current across the talking circuit at the called side of said inductive connections, auxiliary circuits controlled by said last-mentioned pair of relays, and a fifth relay by which the calling subscriber controls the flow of current to that part of the talking circuit allotted to the called substation, said fifth relay having two windings adapted to neutralize each other when energized in parallel, both pairs of relays energized and provided with armatures which remain attracted during conversation.

58. In a telephone system, the combination of a temporarily established talking circuit extending between calling and called subscribers' substations, an inductive connection in each side of said circuit, a centralized source of talking and switching current, subscriber-controlled automatic switching machinery temporarily retained in position to maintain the circuit for talking purposes, said switching machinery provided with a pair of line-relays controllable only by the calling subscriber, the two windings of which constitute the only resistance for bridging the source of current across the talking circuit at the calling side of said inductive connections, auxiliary circuits controlled by said relays, means controlled by said auxiliary circuits having vertical motion to select a group and rotary motion to connect with the desired line in the selected group, another pair of relays controllable by the called subscriber, the windings of which constitute the only resistance for bridging the source of current across the talking circuit at the called side of said inductive connections, auxiliary circuits controlled by said last-mentioned pair of relays, and a fifth relay by which the calling subscriber controls the flow of current to that part of the talking circuit allotted to the called substation, together with a trunk-release-circuit conjointly controlled by said line-relays and one of said second pair of relays, both pairs of relays energized and provided with armatures which remain attracted during conversation.

59. In a telephone system, the combination of a temporarily established talking circuit extending between calling and called

subscribers' substations, an inductive connection in each side of said circuit, a centralized source of talking and switching current, subscriber-controlled automatic switching machinery temporarily retained in position to maintain the circuit for talking purposes, said switching machinery provided with a pair of line-relays controllable only by the calling subscriber, the two windings of which constitute the only resistance for bridging the source of current across the talking circuit at the calling side of said inductive connections, auxiliary circuits controlled by said relays, means controlled by said auxiliary circuits having vertical motion to select a group and rotary motion to connect with the desired line in the selected group, another pair of relays controllable by the called subscriber, the windings of which constitute the only resistance for bridging the source of current across the talking circuit at the called side of said inductive connections, auxiliary circuits controlled by said last-mentioned pair of relays, and a fifth relay by which the calling subscriber controls the flow of current to that part of the talking circuit allotted to the called substation, together with an energizing circuit for said fifth relays, said energizing circuit controlled by one of said line-relays, both pairs of relays energized and provided with armatures which remain attracted during conversation.

60. In a telephone system, the combination of a temporarily established talking circuit extending between calling and called subscribers' substations, an inductive connection in each side of said circuit, a centralized source of talking and switching current, subscriber-controlled automatic switching machinery temporarily retained in position to maintain the circuit for talking purposes, said switching machinery provided with a pair of line-relays controllable only by the calling subscriber, the two windings of which constitute the only resistance for bridging the source of current across the talking circuit at the calling side of said inductive connections, auxiliary circuits controlled by said relays, means controlled by said auxiliary circuits having vertical motion to select a group and rotary motion to connect with the desired line in the selected group, another pair of relays controllable by the called subscriber, the windings of which constitute the only resistance for bridging the source of current across the talking circuit at the called side of said inductive connections, auxiliary circuits controlled by said last-mentioned pair of relays, and a fifth relay by which the calling subscriber controls the flow of current to that part of the talking circuit allotted to the called substation, one of said second pair of relays provided with means for controlling the flow of talking current to the calling subscriber's substation, both pairs of relays energized and provided with armatures which remain attracted during conversation.

ling the flow of talking current to the calling subscriber's substation, both pairs of relays energized and provided with armatures which remain attracted during conversation.

61. In a telephone system, the combination of a temporarily established talking circuit extending between calling and called subscribers' substations, an inductive connection in each side of said circuit, a centralized source of talking and switching current, subscriber-controlled automatic switching machinery temporarily retained in position to maintain the circuit for talking purposes, said switching machinery provided with a pair of line-relays controllable only by the calling subscriber, the two windings of which constitute the only resistance for bridging the source of current across the talking circuit at the calling side of said inductive connections, auxiliary circuits controlled by said relays, means controlled by said auxiliary circuits having vertical motion to select a group and rotary motion to connect with the desired line in the selected group, another pair of relays controllable by the called subscriber, the windings of which constitute the only resistance for bridging the source of current across the talking circuit at the called side of said inductive connections, auxiliary circuits controlled by said last-mentioned pair of relays, and a differentially-wound relay by which the calling subscriber controls the flow of current to that part of the talking circuit allotted to the called substation, one of said second pair of relays provided with means for controlling the flow of talking current to the calling subscriber's substation, both pairs of relays energized and provided with armatures which remain attracted during conversation.

62. In a telephone system, the combination of a temporarily established talking circuit extending between calling and called subscribers' substations, an inductive connection in each side of said circuit, a centralized source of talking and switching current, subscriber-controlled automatic switching machinery temporarily retained in position to maintain the circuit for talking purposes, said switching machinery provided with a pair of line-relays controllable only by the calling subscriber, the two windings of which constitute the only resistance for bridging the source of current across the talking circuit at the calling side of said inductive connections, auxiliary circuits controlled by said relays, means controlled by said auxiliary circuits having vertical motion to select a group and rotary motion to connect with the desired line in the selected group, another pair of relays controllable by the called subscriber, the windings of which constitute the only resistance for bridging the source of current across the

5 talking circuit at the called side of said inductive connections, auxiliary circuits controlled by said last-mentioned pair of relays, and a fifth relay by which the calling subscriber controls the flow of current to that part of the talking circuit allotted to the called substation, said fifth relay having two windings adapted to neutralize each other when energized in parallel, one of said
 10 second pair of relays provided with means for controlling the flow of talking current to the calling subscriber's substation, both pairs of relays energized and provided with armatures which remain attracted during
 15 conversation.

63. In a telephone system, the combination of a temporarily established talking circuit extending between calling and called subscribers' substations, an inductive connection in each side of said circuit, a centralized source of talking and switching current, subscriber-controlled automatic switching machinery temporarily retained in position to maintain the circuit for talking purposes, said switching machinery provided with a pair of line-relays controllable only by the calling subscriber, the two windings of which constitute the only resistance for bridging the source of current across the talking circuit at the calling side of said inductive connections, auxiliary circuits controlled by said relays; means controlled by said auxiliary circuits having vertical motion to select a group and
 25 rotary motion to connect with the desired line in the selected group, another pair of relays controllable by the called subscriber, the windings of which constitute the only resistance for bridging the source of current across the talking circuit at the called side of said inductive connections, auxiliary circuits controlled by said last-mentioned pair of relays, and a fifth relay by which the calling subscriber controls the flow of current to that part of the talking circuit allotted to the called substation, one of said last-mentioned pair of relays provided with means for shifting or transposing the winding of one of the line-relays from one pole
 30 of said source of current to the other, both pairs of relays energized and provided with armatures which remain attracted during conversation.

64. In a telephone system, the combination of a pair of line-relays, means having vertical and rotary switching movements controlled thereby, a third relay, release mechanism, a trunk-release-circuit jointly controlled by said three relays, a
 35 differential-relay, an energizing circuit for said third relay, controlled by said differential-relay, and a local energizing circuit for said differential-relay.

65. In a telephone system, the combination of a pair of line-relays, means having

vertical and rotary switching movements controlled thereby, a third relay, release mechanism, a trunk-release-circuit jointly controlled by said three relays, a differential-relay, an energizing circuit for
 40 said third relay, controlled by said differential-relay, and a local energizing circuit for said differential-relay, controlled by one of said line-relays.

66. In a telephone system, the combination of a pair of line-relays, means having vertical and rotary switching movements controlled thereby, a third relay, release mechanism, a trunk-release-circuit jointly controlled by said three relays, a
 45 differential-relay, an energizing circuit for said third relay, controlled by said differential-relay, and an energizing circuit for said differential-relay, controlled by one of said line-relays.

67. In a telephone system, the combination of a talking circuit, a connector provided with means having vertical motion to select groups and rotary motion to connect with the called lines therein, a release mechanism, a release-magnet, a release-relay, an energizing circuit for said release-relay, including a portion of said talking circuit, a differential-relay controlling said energizing circuit, and a local circuit for energizing
 50 said differential-relay.

68. In a telephone system, the combination of a talking circuit, a connector provided with means having vertical motion to select groups and rotary motion to connect with the called lines therein, a release mechanism, a release-magnet, a release-relay, an energizing circuit for said release-relay, including a portion of said talking circuit, a differential-relay controlling said energizing circuit, and a local circuit for energizing said differential-relay, together with a line-relay controlling said local circuit.

69. In a telephone system, the combination of a talking circuit, a connector provided with means having vertical motion to select groups and rotary motion to connect with the called lines therein, a release mechanism, a release-magnet, a release-relay, an energizing circuit for said release-relay, including a portion of said talking circuit, a differential-relay controlling said energizing circuit, and a local circuit for energizing said differential-relay, together with a line-relay controlling said local circuit, and a trunk-release-circuit controlled by said line-relay and release-relay.

70. In a telephone system, the combination of a talking circuit, a connector provided with means having vertical motion to select groups and rotary motion to connect with the called lines therein, a pair of line-relays, a differential-relay, parallel local circuits for the windings of said differential-relay, controlled by said line-relays, closed
 55

when the latter are energized, and a circuit controlled by said differential-relay.

71. In a telephone system, the combination of a talking circuit, a connector provided with means having vertical motion to select groups and rotary motion to connect with the called lines therein, a pair of line-relays, a differential-relay, parallel local circuits for the windings of said differential-relay, controlled by said line-relays, closed when the latter are energized, and a circuit controlled by said differential-relay, including a portion of said talking circuit.

72. In a telephone system, the combination of a talking circuit, a connector provided with means having vertical motion to select groups and rotary motion to connect with the called lines therein, a release mechanism, a release-magnet, a release-relay, an energizing circuit for said release-relay, including a portion of said talking circuit, a differential-relay controlling said energizing circuit, and a local circuit for energizing said differential-relay, said connector being also provided with a busy-release circuit controlled by said release-relay.

73. In a telephone system, the combination of a talking circuit, a connector provided with means having vertical motion to select groups and rotary motion to connect with the called lines therein, a release mechanism, a release-magnet, a release-relay, an energizing circuit for said release-relay, including a portion of said talking circuit, a differential-relay controlling said energizing circuit, and a local circuit for energizing said differential-relay, together with a line-relay controlling said local circuit, said connector being also provided with a busy-release circuit controlled by said release-relay.

74. In a telephone system, the combination of a talking circuit, a connector provided with means having vertical motion to select groups and rotary motion to connect with the called lines therein, a release mechanism, a release-magnet, a release-relay, an energizing circuit for said release-relay, including a portion of said talking circuit, a differential-relay controlling said energizing circuit, a local circuit for energizing said differential-relay, together with a line-relay controlling said local circuit, and a trunk-release-circuit controlled by said line-relay and release-relay, said connector being also provided with a busy-release circuit controlled by said release-relay.

75. In a telephone system, the combination of a talking circuit, a connector provided with means having vertical motion to select groups and rotary motion to connect with the called lines therein, a pair of line-relays, a differential-relay, parallel local circuits for the windings of said differential-relay, controlled by said line-relays, closed when the latter are energized, a circuit controlled by said differential-relay, said connector being also provided with a busy-release circuit, and electromagnets conjointly controlling said busy-release circuit.

76. In a telephone system, the combination of a talking circuit, a connector provided with means having vertical motion to select groups and rotary motion to connect with the called lines therein, a pair of line-relays, a differential-relay, parallel local circuits for the windings of said differential-relay, controlled by said line-relays, closed when the latter are energized, a circuit controlled by said differential-relay, including a portion of said talking circuit, said connector being also provided with a busy-release circuit, and electromagnets conjointly controlling said busy-release circuit.

77. In a telephone system, the combination of a talking circuit, a connector provided with means having vertical motion to select groups and rotary motion to connect with the called lines therein, a pair of line-relays, a differential-relay, parallel local circuits for the windings of said differential-relay, controlled by said line-relays, closed when the latter are energized, a circuit controlled by said differential-relay, said connector being also provided with a busy-release circuit, normally open and normally closed switch-points in said busy-release circuit, and electromagnets for operating said switch-points and thereby conjointly controlling said busy-release circuit.

78. In a telephone system, the combination of a talking circuit, a connector provided with means having vertical motion to select groups and rotary motion to connect with the called lines therein, a pair of line-relays, a differential-relay, parallel local circuits for the windings of said differential-relay, controlled by said line-relays, closed when the latter are energized, a circuit controlled by said differential-relay, including a portion of said talking circuit, said connector being also provided with a busy-release circuit, normally open and normally closed switch-points in said busy-release circuit, and electromagnets for operating said switch-points and thereby conjointly controlling said busy-release circuit.

79. In a telephone system, the combination of a battery having one pole grounded, a connector provided with means having vertical motion to select groups and rotary motion to connect with the called lines therein, a differential-relay having both of its windings permanently connected with the non-grounded pole of said battery, means for connecting the other terminals of said windings with the grounded pole of the battery, and a release circuit controlled by said differential-relay.

80. In a telephone system, the combination of a battery having one pole grounded, a connector provided with means having vertical motion to select groups and rotary motion to connect with the called lines therein, a pair of line-relays, a differential-relay, parallel local circuits for the windings of said differential-relay, controlled by said line-relays, closed when the latter are energized, a circuit controlled by said differential-relay, said connector being also provided with a busy-release circuit, and electromagnets conjointly controlling said busy-release circuit.

81. In a telephone system, the combination of a battery having one pole grounded, a connector provided with means having vertical motion to select groups and rotary motion to connect with the called lines therein, a pair of line-relays, a differential-relay, parallel local circuits for the windings of said differential-relay, controlled by said line-relays, closed when the latter are energized, a circuit controlled by said differential-relay, said connector being also provided with a busy-release circuit, and electromagnets conjointly controlling said busy-release circuit.

an automatic switch provided with means having vertical and rotary switching movements, a double-wound relay having both of its windings permanently connected with the non-grounded pole of said battery, a telephone transmitter circuit controlled by said relay, means for connecting the other terminals of the said windings with the other pole of the battery, and switching means controlled by said relay.

81. In a telephone system, a line circuit, a transmitter in the line circuit, an automatic connector provided with line-relays, a differential-relay, a circuit controlled by said differential relay, a source of talking current with one pole of which the windings of said differential relay are permanently connected in multiple, and another relay for connecting the said source of current in series between the two line-relays to supply talking current to the said line circuit.

82. A telephone system comprising a line circuit, a transmitter in said circuit, a source of talking current, a condenser in each side of said circuit, bridging relays distributed along the said circuit, switching means controlled by said relays, means for cutting off all except a single pair of relays at each side of said condensers, and means for supplying current only through the said remaining four relays to the said circuit for talking purposes.

83. In a telephone system, automatic switching apparatus normally at rest for extending a connection from a calling to a called line, means whereby talking current is supplied through only two relay windings to the substation of the calling subscriber, and whereby the same kind of current is also supplied through only two relay windings to the substation of the called subscriber, none of said relays being individual to the called subscriber.

84. In a telephone system, an automatic connector having vertical motion to select groups and rotary motion to connect with the called subscriber's line in the selected

group, a pair of line-relays controlling such vertical and rotary motion, and means whereby talking current is supplied through the windings of these relays and no others to the substation of the calling subscriber.

85. A telephone system comprising a line circuit, a transmitter in said circuit, a source of talking current, a condenser in each side of said circuit, bridging relays distributed along said circuit, switching means controlled by said relays, means for cutting off all except a pair of relay windings on each side of said condensers, and means for supplying current only through the remaining four windings to said circuit for talking purposes.

86. In a telephone exchange system, the combination of a pair of relays, a line, a telephone, means for furnishing talking current through the windings of the relay and over the line to the telephone, a permanently grounded spring or contact for said relays, circuits controlled by said relays and including said grounded contact, switch mechanism, and means by which the subscriber employs said relays for controlling said switch mechanism.

87. In a telephone exchange system, the combination of a pair of relays, a line, a telephone, means for furnishing talking current through the windings of the relays and over the line to the telephone, a permanently grounded spring or contact for said relays, circuits controlled by said relays and including said grounded contact, switch mechanism, and means by which the subscriber employs said relays for controlling said switch mechanism, said mechanism having one motion to select groups and another motion to connect with the called line by any selected group.

Signed by me at Chicago, Cook county, Illinois, this 5th day of April, 1906.

TALBOT G. MARTIN.

Witnesses:

EDWARD D. FALES,
JOHN ERICKSON.